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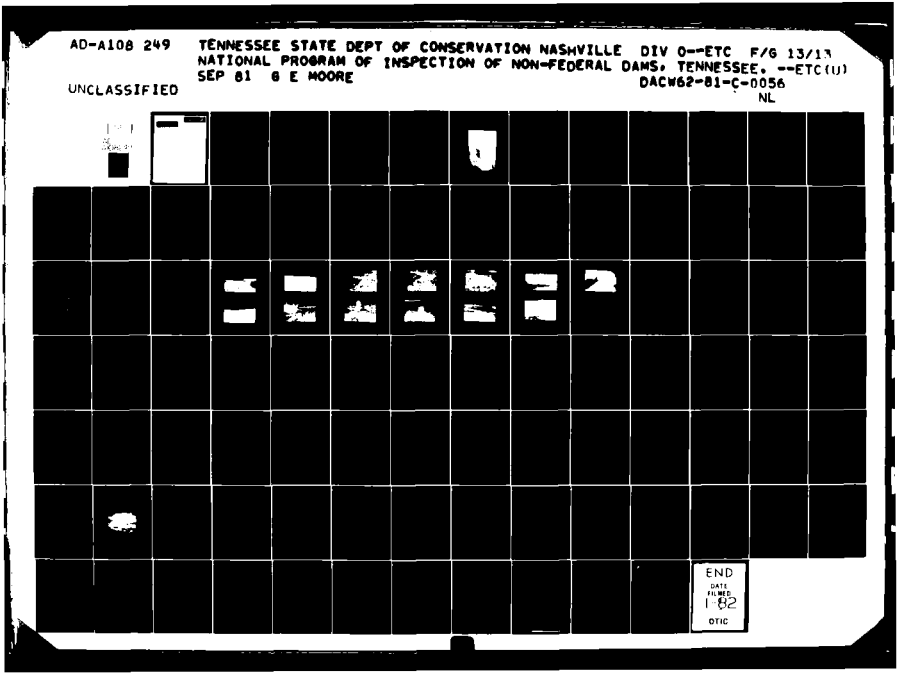

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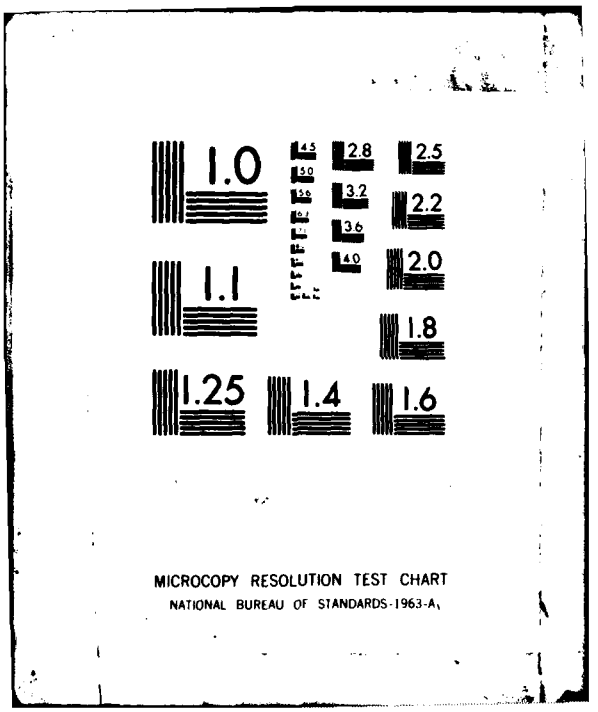
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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A108249	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) National Program of Inspection of Non-Federal Dams, Tennessee. Candlewood Dam (Inventory Number TN 06928) near Saulsbury, Tennessee, Hardeman County, TN., Hatchie River Basin		5. TYPE OF REPORT & PERIOD COVERED Phase 1 Investigation Report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s) DACW-62-81-C-0056
9. PERFORMING ORGANIZATION NAME AND ADDRESS Tennessee Department of Conservation Division of Water Resources 4721 Trousdale Dr., Nashville, TN 37220		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Nashville P.O. Box 1070 Nashville, TN 37202		12. REPORT DATE September, 1981 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams
Dam Safety
National Dam Safety Program
Candlewood Dam, TN
Saulsbury, TN
Hardeman County, TN
Embankments
Visual Inspection
Structural Analysis

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Report is based on the findings of a Phase I inspection of Candlewood Lake Dam. The zoned earthfill embankment is 43.6 feet high and 800 feet long with a crest width of 24 feet. The embankment slopes are 1V:4.3H upstream and 1V:3.4H downstream. The dam impounds 574 acre-feet at normal pool level with 298 acres of flood storage. The drainage area is 167 acres. The service spillway is a steel stand pipe connected to a 30 inch steel pipe passing under the dam. The drawdown drain is a 24 inch gate valve at the base of the riser. The emergency spillway is an earth saddle with a parabolic asphalt control section.

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The emergency spillway has a maximum depth of 6.1 feet and a top width of 185 feet. The dam is in the intermediate size and high hazard potential category. The reservoir has sufficient storage/spillway capacity to safely pass the full PMF. Erosion is evident in the emergency spillway channel, on the embankment abutment contracts, and on the downstream slope. Indications of dispersive soils were noted on the downstream slope. Also, the downstream slope appeared to be excessively moist and some standing water was seen. Due to these findings, Candlewood Lake Dam is considered to be "significantly deficient".

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DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1070
NASHVILLE, TENNESSEE 37202

IN REPLY REFER TO
ORNED-G

2 SEP 1981

Honorable Lamar Alexander
Governor of Tennessee
Nashville, TN 37219

Dear Governor Alexander:

Furnished herewith is the Phase I Investigation Report on Candlewood Lake Dam near Bolivar, Tennessee. The report was prepared under the authority and provisions of PL 92-367, the National Dam Inspection Act, dated 8 August 1972.

The report presents details of the field inspection, background information, technical analyses, findings, and recommendations for improving the condition of the dam.

Based upon the inspection and subsequent evaluation, Candlewood Lake Dam is classified as significantly deficient due to excessive erosion of the embankment and emergency spillway.

We do not consider this an emergency situation at this time, but the recommendation concerning repair and stabilization of all erosion on the dam and others contained in this report should be undertaken in the near future.

Public release of the report and initiation of public statements fall within your prerogative. However, under provisions of the Freedom of Information Act, the Corps of Engineers is required to respond fully to inquiries on information contained in the report and to make it accessible for review on request.

Your assistance in keeping me informed of any further developments will be appreciated.

Sincerely,

LEE W. TUCKER
Colonel, Corps of Engineers
Commander

1 Incl
As stated

CF:
Mr. Robert A. Hunt, Director
Division of Water Resources
4721 Trousdale Drive
Nashville, TN 37220

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
TENNESSEE

Name of Dam ..... Candlewood Lake

County ..... Hardeman

Stream ..... Trib. of East Fork of Spring Creek

Date of Inspection ..... January 23, 1981

This investigation and evaluation was prepared by the Tennessee Department of Conservation, Division of Water Resources.

Prepared By:

George E. Moore
Regional Engineer

Approved By:

Edmond B. O'Neill
Chief Engineer
Safe Dams Section

Approved By:

Robert A. Hunt, P.E.
Director, Division of
Water Resources
Tennessee Department
of Conservation

OVERVIEW PHOTOGRAPH

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam ..... Candlewood Lake

County ..... Hardeman

Stream ..... Trib. of East Fork of Spring Creek

Date of Inspection ..... January 23 1981

ABSTRACT

This report is based on the findings of a Phase I inspection of Candlewood Lake Dam. The zoned earthfill embankment is 43.6 feet high and 800 feet long with a crest width of 24 feet. The embankment slopes are 1V:4.3H upstream and 1V:3.4H downstream. The dam impounds 574 acre-feet at normal pool level with 298 acres of flood storage. The drainage area is 167 acres. The service spillway is a steel stand pipe connected to a 30 inch steel pipe passing under the dam. The drawdown drain is a 24 inch gate valve at the base of the riser. The emergency spillway is an earth saddle with a parabolic asphalt control section. The emergency spillway has a maximum depth of 6.1 feet and a top width of 155 feet. The dam is in the intermediate size and high hazard potential category. The reservoir has sufficient storage/spillway capacity to safely pass the full PMF. Erosion is evident in the emergency spillway channel, on the embankment abutment contacts, and on the downstream slope. Some indications of dispersive soils were noted on the downstream slope. Also, the downstream slope appeared to be excessively moist and some standing water was seen. Due to these findings, Candlewood Lake Dam is considered to be "significantly deficient".

TABLE OF CONTENTS

LIST OF APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

SECTION 1 - GENERAL

1.1 Authority - The Phase I inspection of this dam was carried out under the authority of Tennessee Code Annotated, Sections 70-2501 to 70-2530, The Safe Dams Act of 1973, and in cooperation with the U. S. Army Corps of Engineers under the authority of Public Law 92-367, The National Dam Inspection Act.

1.2 Purpose and Scope - The purpose of a Phase I investigation is to develop an engineering assessment of the general condition of a dam with respect to safety and stability. This is accomplished by conducting a visual inspection, reviewing any available design and construction data, and performing appropriate hydraulic, hydrologic, and other analyses. A comprehensive description of the Phase I investigation program is given in Recommended Guidelines for Safety Inspection of Dams, Department of the Army, Chief of Engineers, Washington, D. C. 20314.

1.3 Past Inspections - Past inspections of Candlewood Lake Dam include a cursory inspection by George Moore and Troy Wedekind of the Tennessee Division of Water Resources on February 14, 1979. Some erosion on the downstream slope and the lack of a vegetative cover on the emergency spillway were noted at this time. Several inspections were made during the construction of the dam by Ed O'Neill also of the Tennessee Division of Water Resources.

1.4 Miscellaneous Details - The day of the inspection was clear with light breezes and an ambient temperature of about 45°F. A rainfall had occurred on February 20, 1981, three days before the inspection. The rainfall was not sufficient to raise the lake level to normal elevation but it did somewhat obscure the normal conditions on the downstream slope of the dam.

1.5 Inspection Team Members - The inspection was conducted by the following State personnel:

Ed O Neill, Chief Engineer
George Moor , Regional Engineer
Anthony Privett, Engineering Co-op

SECTION 2 - PROJECT DESCRIPTION

2.1 Location - The project is located in Hardeman County, Tennessee, about 4 miles east of Saulsbury, Tennessee. The dam is located on the Saulsbury topographic quadrangle at 89°01'05" west longitude and 35°02'53" north latitude. Location maps are provided in Appendix B of this report. The dam intercepts an unnamed tributary about 1 mile from the east fork of Spring Creek. The east fork of Spring Creek flows 5.7 miles to its confluence with several other creeks to form the mainstem of Spring Creek.

2.2 Description

2.2.1 Embankment (Design data is shown in parenthesis) - The Candlewood Lake Dam is a zoned earth embankment dam with a straight alignment, a maximum height of 43.6 feet (35.8 feet), and a length of 800 feet (775 feet). The crest width is 24 feet (30 feet) and the crest elevation is 535 feet msl. The upstream slope is about 1V:4.3H (1V:3H) from the water surface to the crest. The downstream slope is about 1V:3.4H (1V:3H). An asphalt road runs on the crest. The upstream and downstream slopes are covered by grass. The dam is located on the Claiborne and Wilcox formation of the Mississippi Embayment Sediments. These are irregularly bedded sands of the Tertiary Period locally interbedded with lenses and beds of gray and white clay, silty clay, lignitic clay, and lignite. A hand auger sample of the embankment material is a silty clay of group CL in the Unified Soils Classification system. Embankment sketches are provided in Appendix B.

2.2.2 Service Spillway/Drawdown Drain - Both facilities are served by a 30" steel pipe riser and a 30" steel pipe through the dam. The crest elevation of the riser is 521.0' msl. The drawdown drain is a 24" gate valve at the base of the riser.

2.2.3 Emergency Spillway - The emergency spillway, located at the west abutment of the dam, is parabolic in shape with a maximum depth of 6.1' and a top width, at the low point of the dam, of 155'. An asphalt road covers the control section of the spillway. The entrance and exit channels have

sparse vegetation. The maximum capacity of the spillway is estimated to be 4530 cfs. The design plans call for a trapezoidal spillway with a base width of 75 feet and side slopes of 1V:3H with a maximum depth of 2 feet.

2.2.4 Reservoir and Drainage Area - The reservoir has a surface area of 43 acres at normal pool elevation with a fetch of 2000 feet. The normal impounding capacity of the reservoir is estimated to be 574 acre-feet with about 298 acre-feet of flood storage above normal pool. The drainage area is 167 acres and the predominant soils are Ruston, Lexington, and Providence. The watershed is being developed into a medium density residential subdivision.

2.2.5 Miscellaneous - The dam is currently owned by the Candlewood Lakes Property Owner's Association (W. J. Arnold, President). The dam was built in 1976 as a recreational lake for the Candlewood subdivision being developed by the Terra Aqua Corporation. The dam was designed by Ragon Engineering Company with soils testing subcontracted to Construction Materials Lab, Inc. The construction was performed by Frank Mustin of Memphis and by S & W Construction Company. The drainage filter under the toe of the dam was installed about a year after completion of the initial construction. The installation required partial excavation of the downstream slope. No other major repairs have been reported. A Certificate of operation was issued by the State in 1976. Ownership of the lake was turned over to the Property Owner's Association in 1979. No instrumentation was found.

SECTION 3 - INSPECTION FINDINGS

3.1 Specific Findings

3.1.1 Jug holes (indicative of dispersive soils) and other erosion are occurring on the downstream slope. A change in vegetation and erosion patterns occurs about halfway down the slope at the maximum section forming a horizontal line across the downstream slope. A major part of the erosion is occurring above the line which is apparently the result of repair work on the downstream slope. The lower part of the embankment has a much denser grass cover than the upper part. Some erosion is occurring near the toe but no evidence of jugging was seen. Also the entire downstream slope was wet in comparison with the upstream slope and other dams seen on the same day. One area of standing water was found about 5 feet above the toe and 100 feet left of the service spillway. No flow or evidence of the transport of embankment material was seen.

3.1.2 The emergency spillway entrance and exit channels and side slopes are almost devoid of vegetative cover. The exit channel has a relatively steep slope and some erosion gullies have formed. A large amount of material has been mechanically removed from the right edge of the downstream slope. This could possibly allow flow to impinge upon the embankment during high stages.

3.1.3 Gullies have formed on both the upstream and downstream slope on the right embankment abutment contact. The upstream gully is about 3 feet deep and the downstream gully is about 15 feet deep.

3.1.4 The upstream slope has no wave protection and some minor erosion and sloughing has occurred.

3.1.5 Standing water was seen in what appears to be a low area about 25 feet left of the channel and 50 feet downstream of the toe. No evidence of flow from the area was seen.

3.1.6 A flow of about 1 gpm was coming from the service spillway although the water level was below the spillway crest indicating a possible leak in the drawdown drain.

3.1.7 According to OCE guidelines, the dam is in the intermediate size and high hazard potential classifications. As such, the structure is required to pass the full probable maximum flood (PMF). The volume of inflow during the PMF using Antecedent Moisture Condition II (AMC II) is 381 acre-feet. Analysis indicates that the structure can safely pass the AMC II PMF with about 5 feet of freeboard. Routing of the 1-10 day 100-year storm indicates that it will pass the structure with no flow through the emergency spillway.

3.1.8 The project is located in seismic zone 2.

3.1.9 A sample of the embankment material shows a silty clay of group CL in the Unified Classification System. The sample is a shallow depth (0.5-2.0') hand auger sample taken near the crest.

3.1.10 This dam is in the high hazard potential classification as outlined in the OCE guidelines. Failure of the dam could affect the maintenance office and the guard shack for the Candlewood subdivision, a main line of Southern Railway into Memphis, and State Highway 57, all of which are located within 0.2 miles downstream of the dam.

3.1.11 The measured configuration of the dam differs considerably from the design plans. The height of the dam measured from the service spillway outlet invert is 43.6 feet whereas the design dimension is 35.8 feet. The normal pool elevations are about 2 feet higher than designed and the freeboard is 5.6 greater. The maximum depth of the emergency spillway has been increased from 2.1 feet to 6.1 feet. The design slopes of the dam are 1V:3H, the measured slopes are 4.3H:1V upstream, and 1V:3.4H downstream. The crest width was decreased from 30 feet to 24 feet.

3.2 Conclusions and Recommendations

3.2.1 Conclusions

a. Indications of the possible presence of dispersive soils were found on the embankment.

b. Erosion on the embankment and in the emergency spillway is becoming excessive.

c. The downstream slope was excessively wet. The wetness is thought to be due to repair of gullied areas with uncompacted fill.

d. The structure appears to be adequate with respect to hydraulic and hydrologic considerations. However, at high stages, flow through the emergency spillway could impinge on the embankment.

e. The seismic resistance of this structure is unknown, but under this program, dams in seismic zone 2 may be assumed to be adequate against seismic loading if judged adequate in static stability requirements.

f. Due to these conclusions, this dam is considered to have a condition classification of "significantly deficient".

3.2.2 Recommendations

a. A qualified engineer should be engaged to:

1) Check for the presence of dispersive soils and recommend and implement action as necessary to stabilize the soils.

2) Provide recommendations for repair and stabilization of all erosion on the embankment, abutments, and in the emergency spillway.

3) Provide recommendations for regrading the emergency spillway exit channel so that flow will not impinge upon the embankment.

b. A soil binding grass cover should be established on all remolded areas and the grass cover on the upper portion of the downstream slope should be improved.

c. An emergency action plan should be developed to notify downstream residents in the event of a potentially hazardous situation.

d. A program of routine maintenance and periodic inspection should be established for the dam.

SECTION 4 - REVIEW BOARD FINDINGS

The Interagency Review Board for the National Program of Inspection of Non - Federal Dams met in Nashville on 18 June 1981 to examine the technical data contained in the Phase I investigation report on Candlewood Lake Dam. The Review Board considered the information and recommended that (1) the removal of material from the emergency spillway by mechanical means should not be allowed to continue, (2) the reason for the discontinuity on the embankment should be determined and included in the report, (3) an emergency action plan should be developed, including a warning system to alert downstream residents, in the event a serious condition develops with the project. (4) the owner should establish a regular program of inspection and maintenance to provide detection and timely correction of problem areas, and (5) the condition classification should be changed from "deficient" to "significantly deficient". They agreed with other report conclusions and recommendations. A copy of the letter report presented by the Review Board is included in Appendix F.

APPENDIX A

DATA SUMMARY

APPENDIX A
DATA SUMMARY

A.1 Dam

A.1.1 Type - Zoned earthfill, linear alignment dam with a steel pipe service spillway and drawdown drain and an earth channel emergency spillway with a paved control section.

A.1.2 Dimensions and Elevations - (Elevations taken from design plans. Field measurements, shown parenthetically if different from design plans, are referenced to the top of the service spillway headwall at elevation 496.1' msl.)

a. Crest length - 775' (800')
b. Crest width - 30' (24')
c. Height - 35.8' (43.6')
d. Crest elevation - 527.5' msl (535')
e. Service spillway elevation - 521' msl (522.9')
f. Emergency spillway elevation - 525.5' msl (528.9')
g. Embankment slope, U/S - 1V:3H (1V:4.3H)
h. Embankment slope, D/S - 1V:3H (1V:3.4H)
i. Size classification - Intermediate

A.1.3 Zones, Cutoffs, Grout Curtains

A.1.3.1 Zones (Fill material given as per Unified Classification System)

a. Core material - CL
b. Core slopes (max.) - 1V:½H
c. U/S zone material - random fill
d. D/S zone (1) material - random fill
e. D/S zone (1) slopes (max.) - 1V:1½H
f. D/S zone (2) material - SP-SC

A.1.3.2 Cutoff Trench (Filled as part of core)

a. Base width - 10'
b. Side slopes - 1V:2H
c. Bottom elevation - 470' msl (approx.)

A.1.3.3 Grout Curtains - None

A.2 Reservoir and Drainage Area

A.2.1 Reservoir - (Normal pool elevation 521' msl, 6.5' below the effective crest of the dam as per design plans)

a. Surface area - 43 acres
b. Fetch - 2000 feet
c. Capacity (normal) - 574 acre-feet
d. Capacity (top of dam) - 872 acre-feet

A.2.2 Drainage Area

a. Size - 167 acres
b. Maximum relief - 100'
c. Soil - Ruston (B), Lexington (B), Providence (B)
d. Cover - Medium density residential
e. Runoff (P100)(AMC III) - 65.4 acre-feet
f. Runoff (PMF)(AMC II) - 381 acre-feet

A.3 Outlet Structures

A.3.1 Drawdown Drain - (Gate valve at base of service spillway riser)

a. Valve diameter - 24"
b. Invert elevation - 494' msl

A.3.2 Service Spillway - (Steel pipe riser connected to steel pipe with concrete anti-seep collars)

a. Riser diameter - 30"
b. Pipe diameter - 30"
c. Pipe length - 240'
d. Gradient - 1%
e. Anti-seep collars, size - 6" x 6' x 6'
f. Anti-seep collars, number and spacing - 12 @ 20'
g. Spillway capacity - 135 cfs

A.3.3 Emergency Spillway - (Trapezoidal, vegetated earth saddle with paved control section through left abutment)

a. Base width - 75'
b. Side slope - 3V:1H
c. Control section length - 30' (24)
d. Entrance slope - 2% (8.2%)
e. Exit slope - 17.5% (10%)
f. Capacity (design) - 1371 cfs

The emergency spillway was measured to be parabolic with the following dimensions:

g. Top width - 155'
h. Maximum depth - 6.1'
i. Capacity (measured) - 4530 cfs

A.4 Historical Data

A.4.1 Construction Date - 1976

A.4.2 Designer - Ragon Engineering Company
Bolivar, Tennessee

A.4.3 Soils Testing - Construction Materials Lab, Inc.
Jackson, Tennessee

A.4.4 Builder - S & W Construction Company
Memphis, Tennessee

A.4.5 Developer - Terra Aqua Corporation

A.4.6 Owner - Candlewood Lakes Property Owner's
Assn., W. J. Arnold, President

A.4.7 Previous Inspections - February 1979

A.4.8 Seismic Zone - 2

A.5 Downstream Hazard Data

A.5.1 Downstream Hazard Potential Classification

a. Corps of Engineers - High
b. State of Tennessee - 1

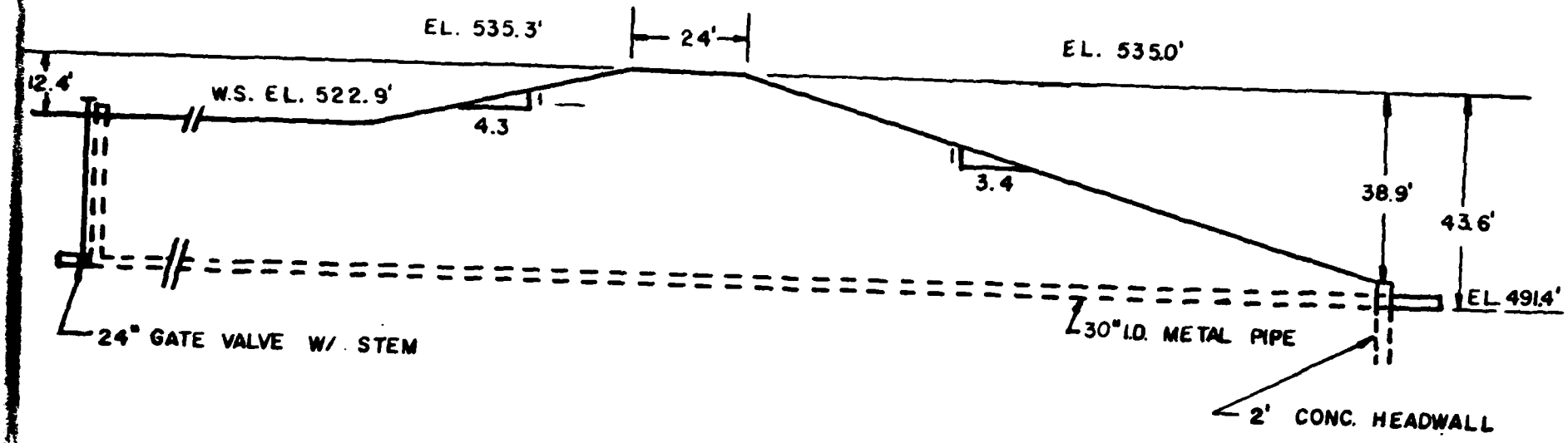
A.5.2 Persons in Probable Flood Path - variable,
generally less than 5

A.5.3 Downstream Property - US Hwy 57, mainline
Southern Railroad, maintenance office guard
shack, all within 0.2 miles of dam

A.5.4 Warning Systems - None

APPENDIX B

SKETCHES AND LOCATION MAP



MAXIMUM SECTION

SCALE: 1" = 30'

CANDLEWOOD DAM	
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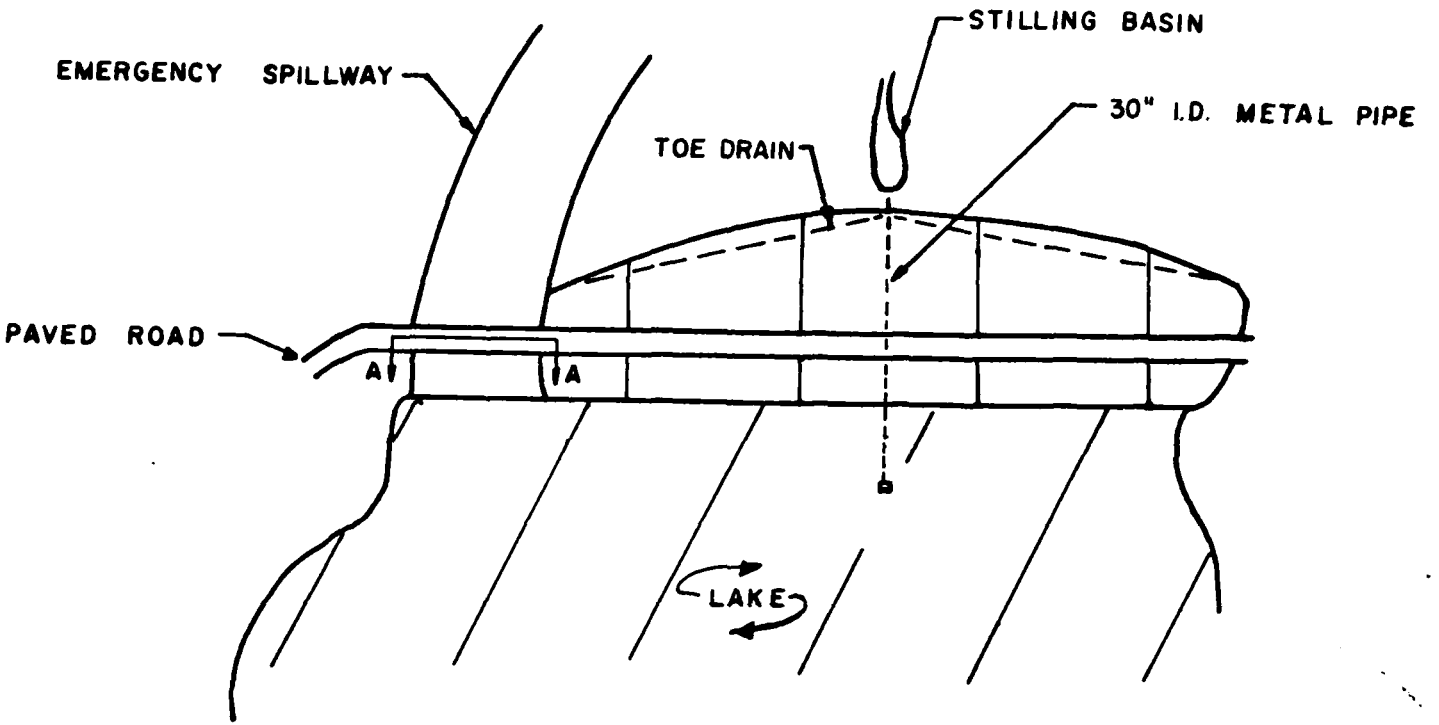
DATE:	12 MAY 81
SHEET:	2 OF 4

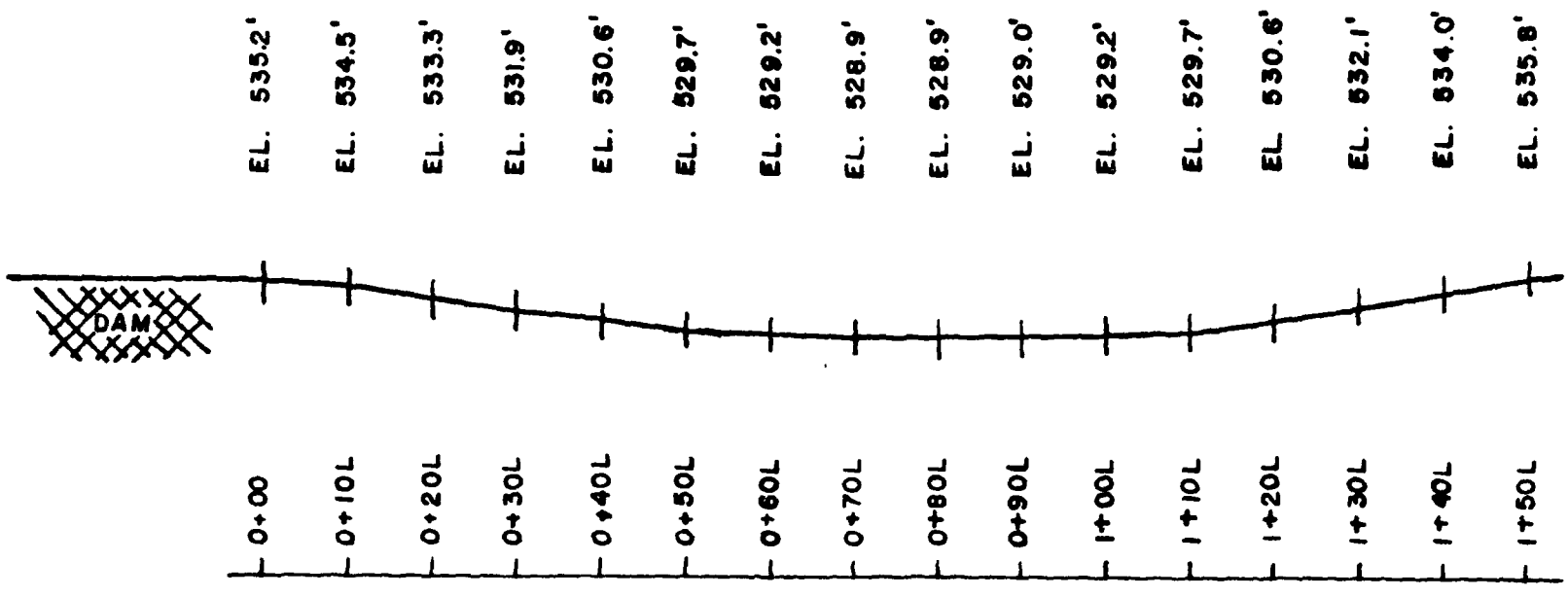


GENERAL PLAN

SCALE: 1" = 200'

CANDLEWOOD DAM

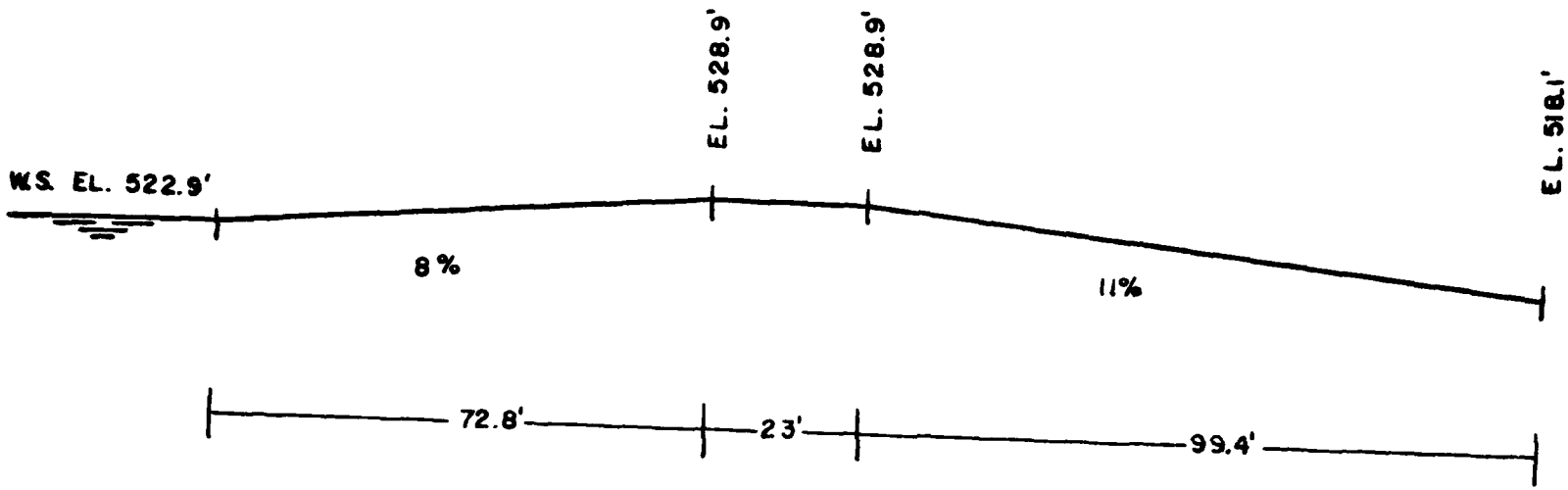
DRAWN BY: J. G.
DATE: 12 MAY 81
SHEET: 1 OF 4



EMERGENCY SPILLWAY CONTROL SECTION A—A

SCALE: 1" = 20'

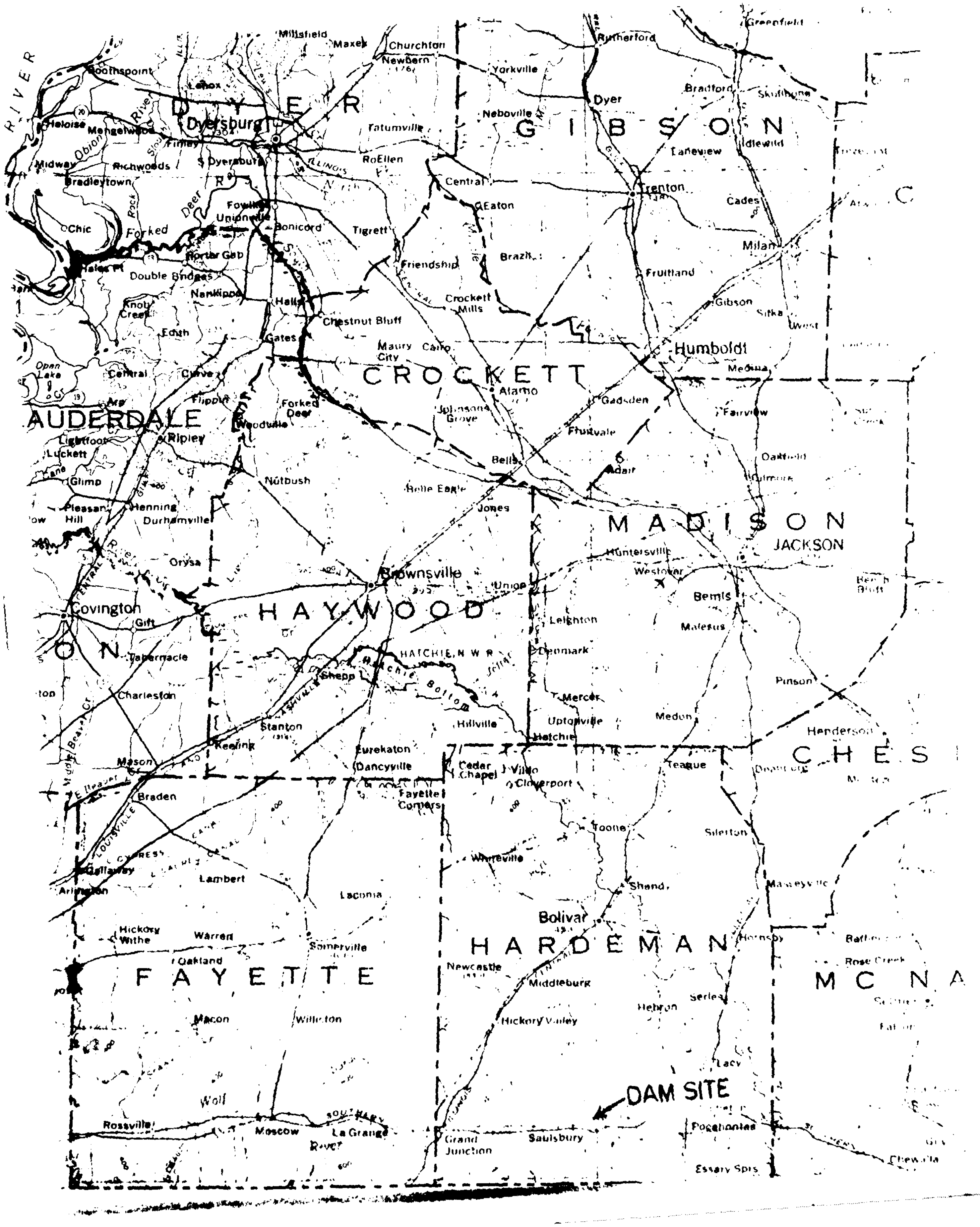
CANDLEWOOD DAM
DRAWN BY: J.G.
DATE: 12 MAY 81
SHEET 3 OF 4



EMERGENCY SPILLWAY PROFILE

SCALE: 1" = 25'

CANDLEWOOD DAM
DRAWN BY: J.G.
DATE : 12 MAY 81
SHEET: 4 OF 4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Newbern
Yorkville
Rutherford
Greenfield
Boothspoint
Lenox
Bradford
Skullbone
Heloise
Mengelwood
Finley
Tatumville
Neboville
Dyer
Laneview
Idlewild
Midway
Richwoods
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RoEllen
Trenton
Bradleytown
Central
Eaton
Cades
Fowlkes
Unionville
Bonicord
Tigrett
Brazil
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Porter Gap
Friendship
Fruitland
Hales Pt
Double Bridges
Nankipoo
Halls
Crockett Mills
Gibson
Sitka
Knob Creek
Chestnut Bluff
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Gates
Maury City
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Medina
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Cleveland
Alamo
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Fairview
Flippin
Forked Deer
Johnsons Grove
Woodville
Fruitvale
Lightfoot
Ripley
Luckett
Bells
Adair
Oakfield
Glimp
Nutbush
Belle Eagle
Gilmore
Pleasant Hill
Henning
Jones
Durhamville
Orysa
Huntersville
Brownsville
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Cedar Chapel
Teague
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Fayette Corners
Cloverport
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Whiteville
Galloway
Lambert
Arlington
Laconia
Shandy
Masseyville
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Warren
Bolivar
Hornsby
Oakland
Somerville
Newcastle
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Middleburg
Macon
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Hickory Valley
Hebron
Serles
Lacy
Wolf
Rossville
Moscow
La Grange
Grand Junction
Saulsbury
Pocahontas
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APPENDIX C

PHOTOGRAPHIC RECORD

Photographic Record

Photo No. 1 - The upstream slope of the dam showing minor erosion apparently due to surface runoff.

Photo Nos. 2 & 3 - The downstream slope of the dam showing a discontinuity about midway down the slope.

Photo No. 4 - The left downstream embankment abutment contact. A small gully is hidden by the tall grass in the left of the photo.

Photo Nos. 5-7 - Erosion and possible jug holes on the downstream slope above the discontinuity shown in photos 2 and 3.

Photo No. 8 - The service spillway riser.

Photo No. 9 - The outlets of the service spillway and toe drains.

Photo No. 10 - The entrance channel of the emergency spillway.

Photo No. 11 - The exit channel of the emergency spillway showing erosion and sparse vegetation.

Photo No. 12 - A view of the downstream area from the top of the dam showing an area of standing water to the left of the service spillway outlet.

Photo No. 13 - Aerial view of the dam showing the erosion of the downstream slope and the emergency spillway.

PHOTO NO.1

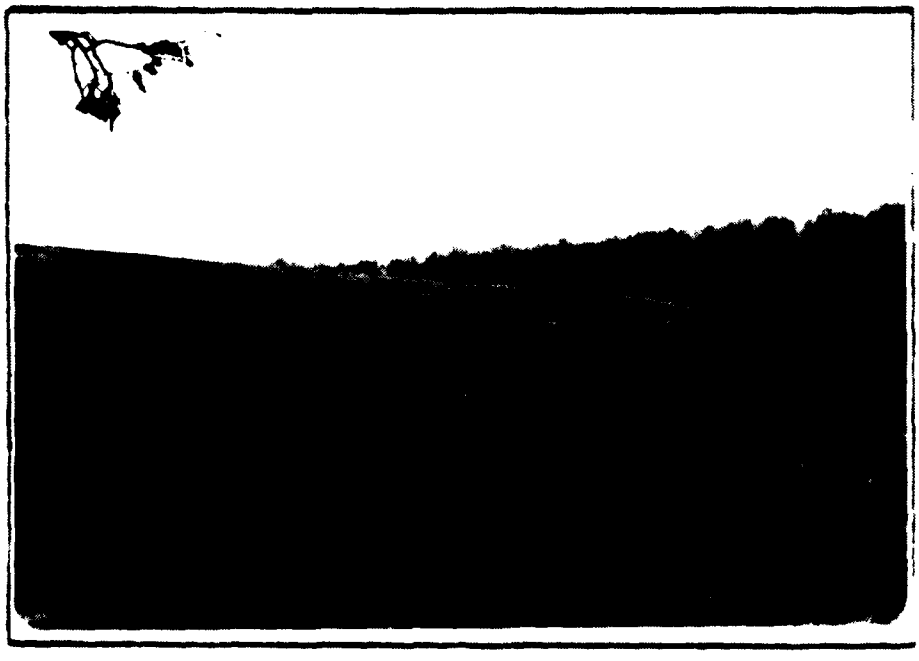


PHOTO NO.2

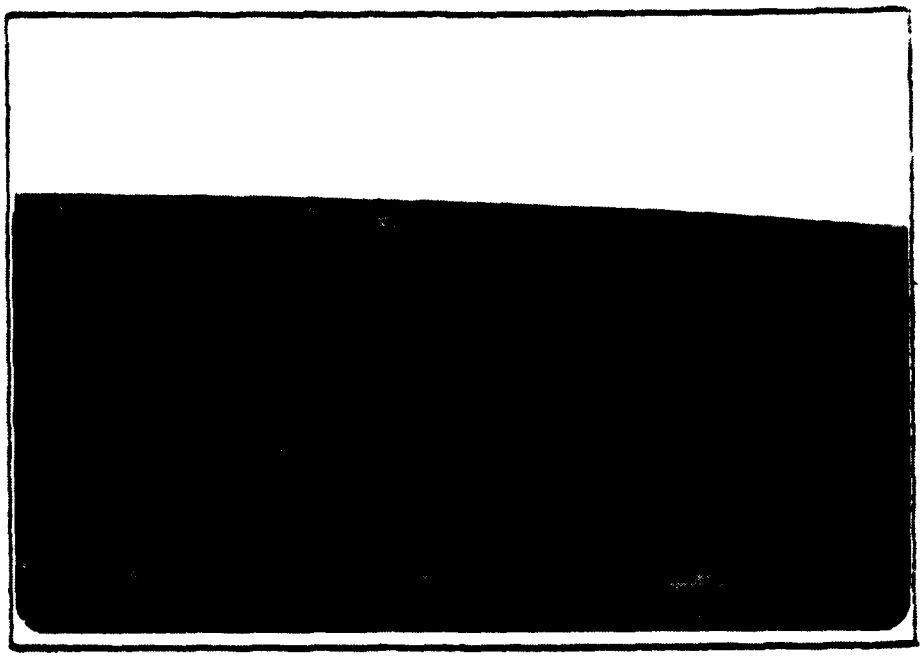


PHOTO NO.3

PHOTO NO.4

PHOTO NO.5

PHOTO NO.6

PHOTO NO.7

PHOTO NO.8

PHOTO NO.9

PHOTO NO.10

PHOTO NO.11

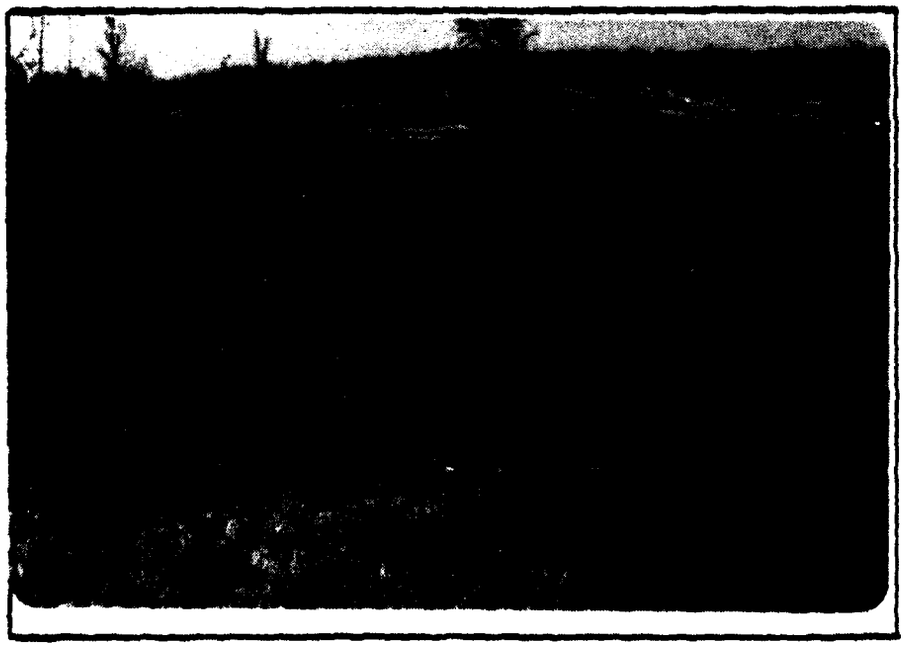


PHOTO NO.12

PHOTO NO. 13

APPENDIX D

CHECKLISTS - VISUAL INSPECTION, ENGINEERING DATA, SOIL TESTS

Check List
Visual Inspection of Earth Dams
Department of Conservation
Division of Water Resources

Name of Dam Candlewood

County Hardeman **Date of Inspection** 1/22/81

ID # - State 35-7022 **Federal** TN-06022

Type of Dam Zoned earthfill

Hazard Category-Federal High **State** 1

Weather Clear **Temperature** 40°

Pool at Time of Inspection 3" below normal pool (top of riser) **(distance from crest)**

Tailwater at Time of Inspection None **(distance from stream bed)**

Design/As Built Drawings Available: Yes X **No** _____

Location: TDWR

Copy Obtained: Yes X **No** _____

Reviewed: Yes X **No** _____

Construction History Available: Yes X **No** _____

Location: TDWR

Copy Obtained: Yes X **No** _____

Reviewed: Yes X **No** _____

Other Records and Reports Available: Yes _____ **No** _____

Location: _____

Copy Obtained: Yes _____ **No** _____

Reviewed: Yes _____ **No** _____

Prior Incidents or Failures: Yes _____ **No** X

Inspection Personnel and Affiliation:

Ed O'Neill - TDWR _____

George Moore - TDWR _____

Anthony Privett - TDWR _____

_____ _____

I. Embankment

A. Crest

Description (1st inspection) Asphaltic concrete road covers crest; straight alignment; east-west orientation.

1. Longitudinal Alignment Good

2. Longitudinal Surface Cracks A few minor cracks in road surface.

3. Transverse Surface Cracks None

4. General Condition of Surface Good

5. Miscellaneous

B. Upstream Slope

1. Undesirable Growth or Debris None

2. **Sloughing, Subsidence, or Depressions** Slight sloughing at water surface due to wave action.

3. **Slope Protection** Has a wave protection berm which is eroding. Will need wave protection in a few years.

   a. **Condition of Riprap** None

   b. **Durability of Individual Stones** N/A

   c. **Adequacy of Slope Protection Against Waves and Runoff** See 3 above. As a maintenance item, stand of fescue should be improved.

   d. **Gradation of Slope Protection - Localized Areas of Fine Material**

4. **Surface Cracks** None

C. **Downstream Slope**

1. **Undesirable Growth or Debris** None

2. **Sloughing, Subsidence, or Depressions; Abnormal Bulges or Non-Uniformity** Surface erosion may become the main problem. A line of erosion gullies and holes seems to be running across the dam at about mid height or slightly above. The dam, just below the erosion, has been seeded in a good stand of grass and fescue. Some holes appear to be caused by dispersive soils.

3. **Surface Cracks on Face of Slope** None

4. **Surface Cracks or Evidence of Heaving at Embankment Toe** None

5. **Wet or Saturated Areas or Other Evidence of Seepage on Face of Slope; Evidence of "Piping" or "Boils"** The entire D/S embankment seemed extremely wet in comparison to the U/S slope and to other dams seen on the same day. The eroded areas are soft, the material appears to be gray clay. An area of standing water was seen on the embankment about 5' above the toe and 100' left of the SS. No flow or evidence of the transport of embankment mtl was found in the area. No other standing water was seen on the embankment. The area should be rechecked during dry weather.

6. **Drainage System** Clear; was installed after dam was built.

7. **Fill Contact with Outlet Structure** O.K. Some surface erosion coming into stilling basin and minor erosion around headwall.

8. **Condition of Grass Slope Protection** Fair to good; needs improvement.

D. Abutments

1. Erosion of Contact of Embankment with Abutment from Surface Water Runoff, Upstream or Downstream

Erosion gully 3' deep U/S right side.

Erosion gully 1.5' deep D/S right side.

2. Springs or Indications of Seepage Along Contact of Embankment with the Abutments Soft area just U/S from toe 30' from right end; appears to be recent dumped fill; is above water line.

3. Springs or Indications of Seepage in Areas a Short Distance Downstream of Embankment - Abutment Tie-in

None

II. Area Downstream of Embankment, Including Channel

A. Localized Subsidence, Depressions, Sinkholes, Etc. _____

B. Evidence of "Piping", "Boils", or "Seepage" _____
Wet area 50' D/S, 25' left of channel; appears to be a low area.

C. Unusual Presence of Lush Growth, such as Swamp Grass, etc. Some

D. Unusual Muddy Water in Downstream Channel _____
None

E. Sloughing or Erosion _____

F. Surface Cracks or Evidence of Heaving Beyond Embankment Toe _____

G. Stability of Channel Sideslopes O.K.

H. Condition of Channel Slope Protection Growing up in weeds but seems stable.

I. Adequacy of Slope Protection Against Waves, Currents, and Surface Runoff _____

J. Miscellaneous _____

K. Condition of Relief Wells, Drains, and Other Appurtenances O.K.

L. Unusual Increase or Decrease in Discharge from Relief Wells None

III. Instrumentation - None

A. Monumentation/Surveys _____

B. Observation Wells _____

C. Weirs _____

D. Piezometers _____

E. Other _____

IV. Spillways

A. Service Spillway (Service/Emergency Combination Yes __ No __)

1. **Intake Structure Condition** Observed from waters edge; appears o.k.

2. **Outlet Structure Condition** O.K.

3. **Pipe Condition** Appears good; observed from D/S end.

4. **Evidence of Leakage or Piping** None

5. **General Remarks**

B. Emergency Spillway

1. **General Condition**

2. **Entrance Channel** O.K.

3. **Control Section** O.K.

3. **Exit Channel** A large amount of mtl has been removed from the right edge of the spillway. This has apparently been due to both mechanical removal and erosion. The channel should be regraded and stabilized to assure that no flow impinges upon the embankment during high stages.

4. **Vegetative/Woody Cover** Trees were left in exit channel as energy dissipator about 150' aft of crest.

5. **Other Observations**

V. Emergency Drawdown Facilities (if part of service spillway so state) Gate valve at base of service spillway riser. Possible 1 gpm leak.

Are Facilities Operable: Yes _____ No _____ Unknown but probable

Were Facilities Operated During Inspection: Yes _____ No X

Date Facilities Were Last Used _____

VI. Reservoir

A. Slopes O.K.

B. Sedimentation Minor

C. Turbidity Clear, green; visibility about 2"

VII. Drainage Area

Description (for hydrologic analysis) Low density residential development with wooded lots.

A. Changes in Land Use

VIII. **Downstream Area (Stream)**

A. **Condition (obstructions, debris, etc.)** Channel constructed by culvert under railroad and highway.

B. **Slopes** Flat

C. **Approximate No. Homes, Population, and Distance D/S**

None

D. **Other Hazards** Hwy 57, main line Southern Railroad, guard house, maintenance shack, information center (trailer) within 0.2 miles D/S.

IX. Miscellaneous

Incidents/Failures None

Observed Geology of Area Sandy clay.

X. Conclusions

Condition satisfactory pending F & U analysis.

D/S slope indicative of dispersive soils.
D/S slope seems unusually wet compared to U/S or to other dam inspected. E/S has been changed from original contour both by erosion and by mechanical force.

XI. Recommendations

Establish good grass cover on D/S slope and E/S exit channel which may require small amount of reshaping.

Monitor wet areas & reinspect in dry weather (TDWR).

Regrade the ES and insure the flow cannot impinge on the dam during high flows.

George S. Moore
Regional Engineer

Chief Engineer

OHIO RIVER DIVISION, NASHVILLE DISTRICT
SOIL TEST DATA SUMMARY

PROJECT CANDLEWOOD HOLE 1 ELEV. TOP _____ SHEET 1 OF 1 SHEETS

SAMPLE NO.	DEPTH OF SAMPLE	LABORATORY CLASSIFICATION	NAT. WATER CONT.	ATTERBERG LIMITS		MECHANICAL ANAL.		
				LL	PL	Gravel %	Sand %	Fines %
1	SURFACE	MOTTLED GRAY, SILTY CLAY (CL)	7.0	46.9	16.2			
		* DRY HARD TEARS HEAVY.						
						P.I.	30.7	
		SAMPLE ARRIVED TO LAB DRIED OUT SINCE IT WAS TAKEN.						

ORH 388
SEPT 67

ORNED-D

APPENDIX E

HYDRAULIC AND HYDROLOGIC DATA

Hydraulic and Hydrologic Calculations

Candlewood Lake Dam is located in Hardeman County, Tennessee. The primary land use is medium density residential development with about 26% of the area under water. The predominant soil types are Ruston (HSG B), Lexington (HSG B), and Providence (HSG C). The runoff curve number was calculated to be 83 AMC II.

The Candlewood Lake Dam is an intermediate, high hazard potential dam. As such, it is required to pass the Probable Maximum Flood (PMF) without overtopping. The PMF is derived from the Probable Maximum Precipitation (PMP). Using the U. S. Weather Service TP-40, the 6-hour PMP was estimated to be 29.7 inches yielding 27.4 inches of runoff.

The total inflow into the reservoir is about 381 acre-feet. with a peak rate of 3947 cfs. Candlewood Lake has a maximum storage above normal pool of 588 acre-feet and a maximum spillway discharge rate of 4666 cfs. The impoundment is sufficient to pass the PMF. The dam contained the storm with flows of 5.9 feet in the emergency spillway and 0.2 feet of freeboard.

Routing of a 1-10 day 100-year storm indicated that the storm would pass with no flow in the emergency spillway.

The inflow hydrograph was calculated by methods contained in Section 4, Chapter 21, of the SCS National Engineering Handbook. Hydraulic calculations were performed in accordance with King & Brater's Handbook of Hydraulics. The routings were taken from NEH-4, Chapter 17. Equation 17-11 was rearranged to the following form:

$$I_1 + I_2 + \left(\frac{2S_1}{\Delta t} - O_1\right) = \frac{2S_2}{\Delta t} + O_2$$

CANDLEWOOD LAKE | HYDROGRAPH COMPUTATION | GEM

LOCATED ON TRIBUTATARY of SPRING CREEK
DRAINAGE AREA = 167 Ac = .26 Mi²
MAJOR SOIL TYPES. - RUSTON, LEXINGTON, PROVIDENCE
MAJOR LAND USE - MEDIUM DENSITY RESIDENTIAL DEVELOPEMENT
CN = 83 AMC II, 93 AMC III
NORMAL POOL AREA = 43 Ac
D/S HAZARD - HIGH
6-HOUR PMP = 29.7 IN
6 HOUR P_{100} = 5.5 IN
Y = 11.9%
ℓ = 1400 ft

AMC II	AMC III
L = .11hr	L = .07hr
T_c = .184hr	T_c = .12hr
T_p = .13 hr (.1277)	T_p = .09 hr (.0867)
PMP = 29.7 IN	PMP = 29.7 IN
Q = 27.4 IN	Q = 28.8 IN
HYDROGRAPH FAMILY #1	HYDROGRAPH FAMILY #1
T_o = 5.81hr	T_o = 5.9 hr
T_o/T_p = 45.5	T_o/T_p = 68
REV T_o/T_p = 50	REV T_o/T_p = 75
REV T_p = .116hr	REV T_p = .079 hr
q_p = 1083 cfs/IN	q_p = 1600 cfs/IN
Q_{qp} = 29673 cfs	Q_{qp} = 46070 cfs
q_{max} = 3947 cfs @ 2.09 hr	q_{max} = 4146 cfs @ 2.13 hr
P_{100} = 5.5 IN	P_{100} = 5.5 IN
Q = 3.6 IN	Q = 4.7 IN
HYDROGRAPH FAMILY #2	HYDROGRAPH FAMILY #1
T_o = 5.1hr	T_o = 5.55 hr
T_o/T_p = 39.9	T_o/T_p = 64
REV T_o/T_p = 36	REV T_o/T_p = 75
REV T_p = .142 hr	REV T_p = .074 hr
q_p = 888 cfs/IN	q_p = 1701 cfs/IN
Q_{qp} = 3198 cfs	Q_{qp} = 7993 cfs
q_{max} = 502 cfs @ 1.53 hr	q_{max} = 719

CANDLEWOOD LAKE WORKING TABLE, PSMC ROUTING

ELEVATION Ft. MSL	SPILLWAY DISCHARGE INST (IN/DAY)	AVG (IN/DAY)	STORAGE INCHES
523.2	0		0
		.43	
523.6	.86		1.22
		2.14	
524.2	3.42		3.07
		10.26	
526.2	17.10		9.49
		17.46	
528.9	17.82		18.7
		28.01	
529.9	38.20		

CANDLEWOOD LAKE PSH AND PSMC 100YR

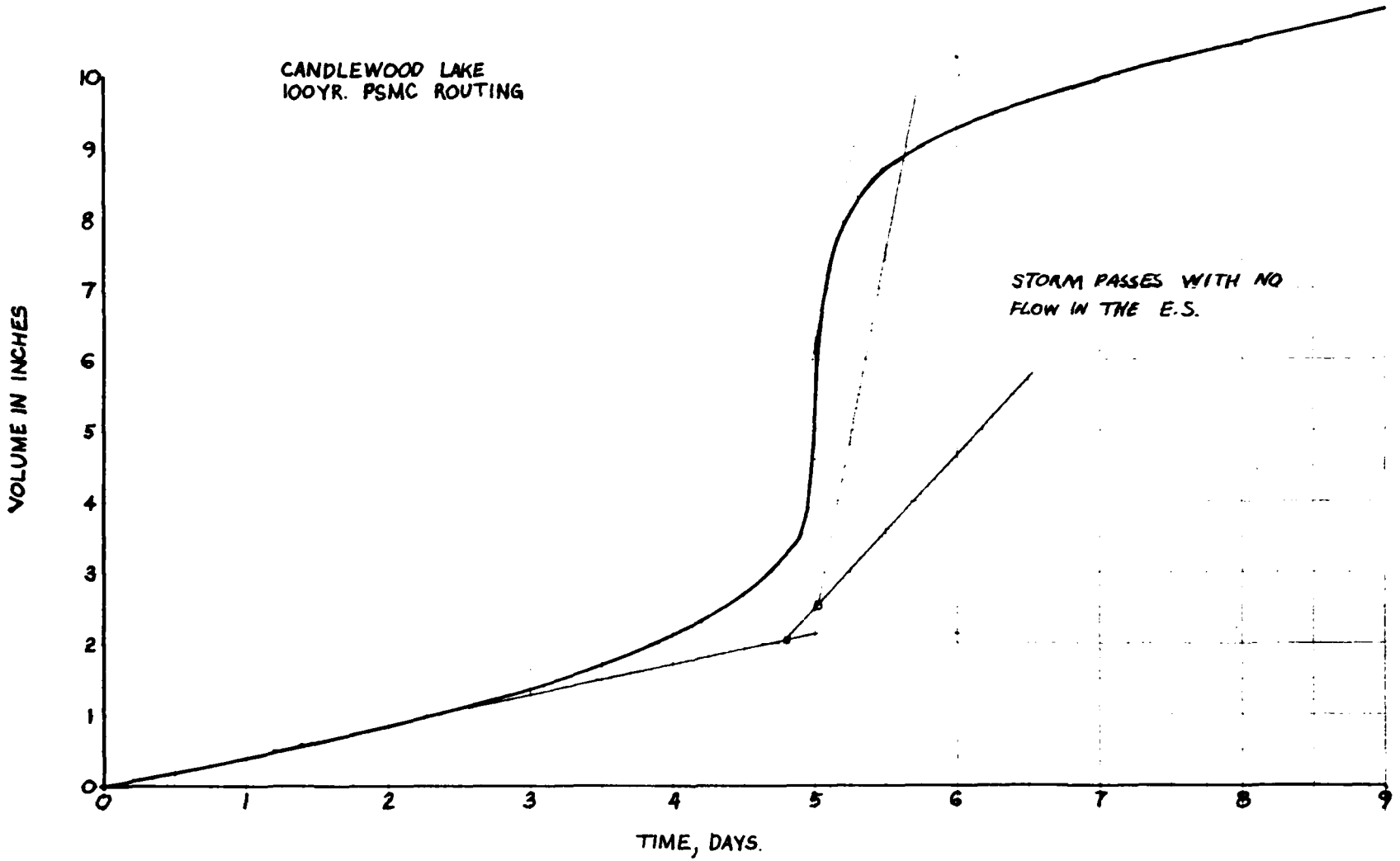
DA = 167 Ac = .26 MI²
Tc .18 hr
AVERAGE ANNUAL PRECIPITATION = 49 IN
AVERAGE ANNUAL TEMPERATURE = 62° F
RUNOFF CN = 83
10 DAY CN = 69
1DAY P_{100} = 7.7 IN
10DAY P_{100} = 14 IN
Q_1 = 5.69 IN
Q_{10} = 9.76 IN

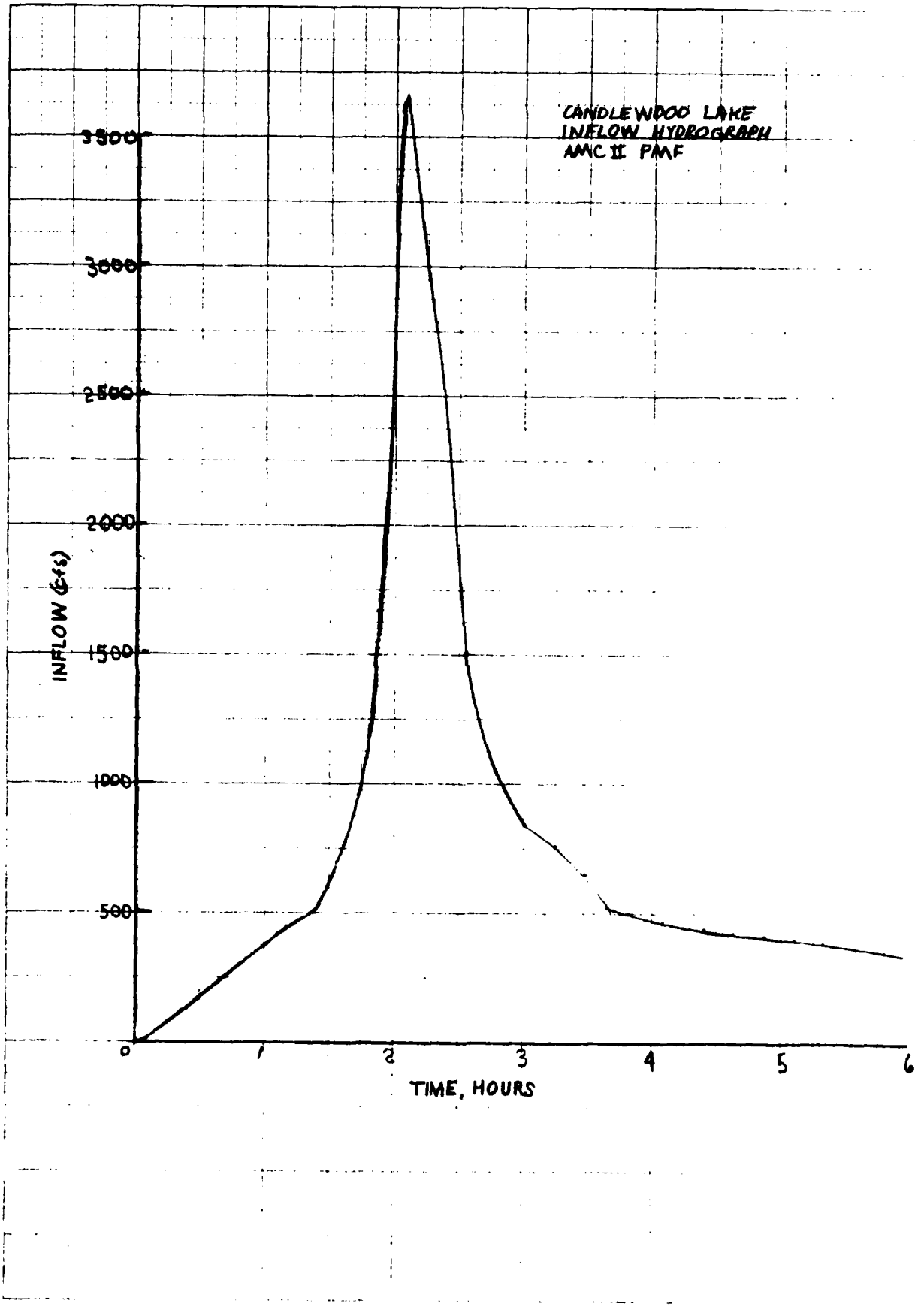
Q_1/Q_{10} = .583
SERIAL No = 5

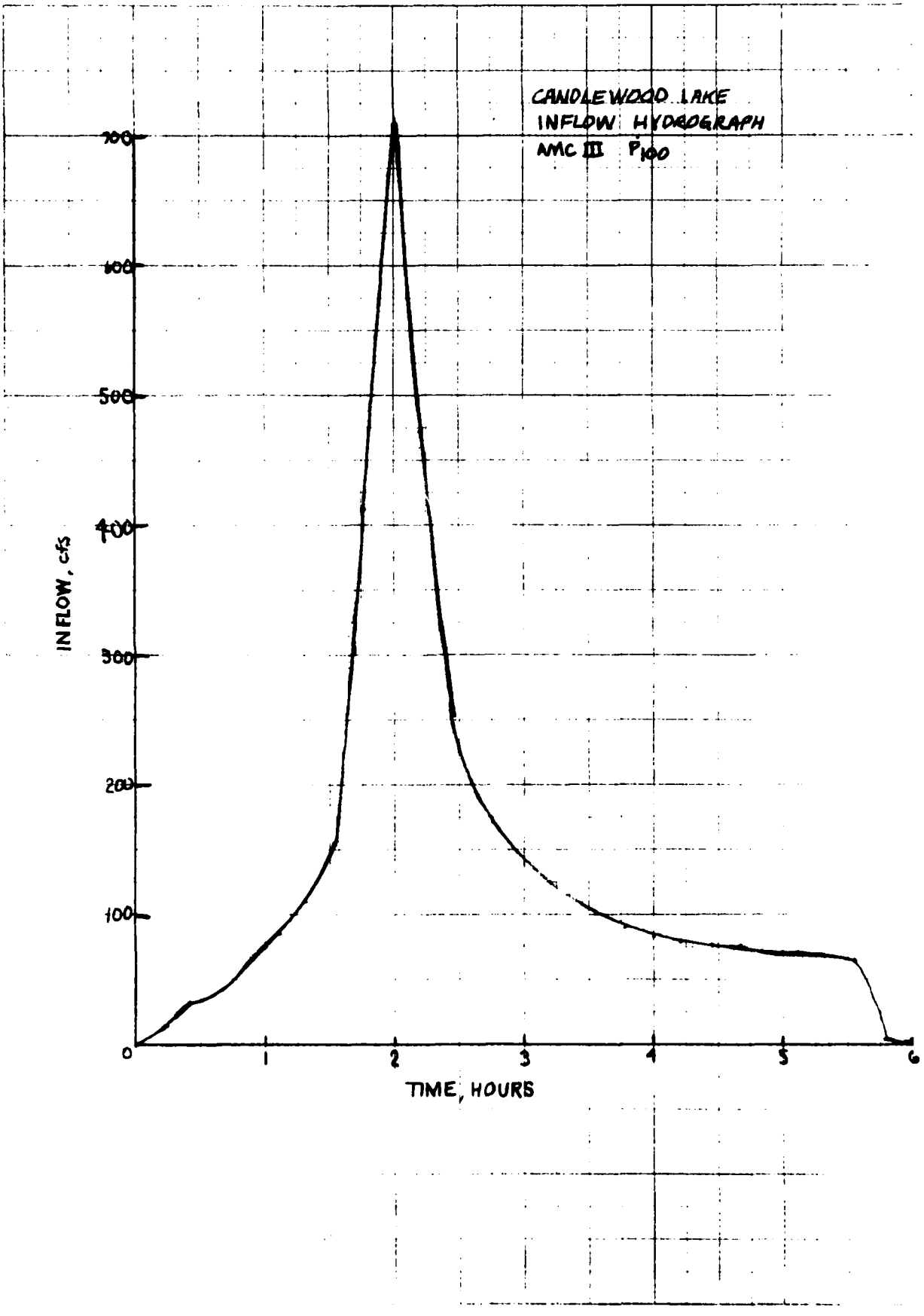
$C_c = \frac{100 P_a}{T_a^2} = \frac{100(49)}{(62)^2} = 1.275$

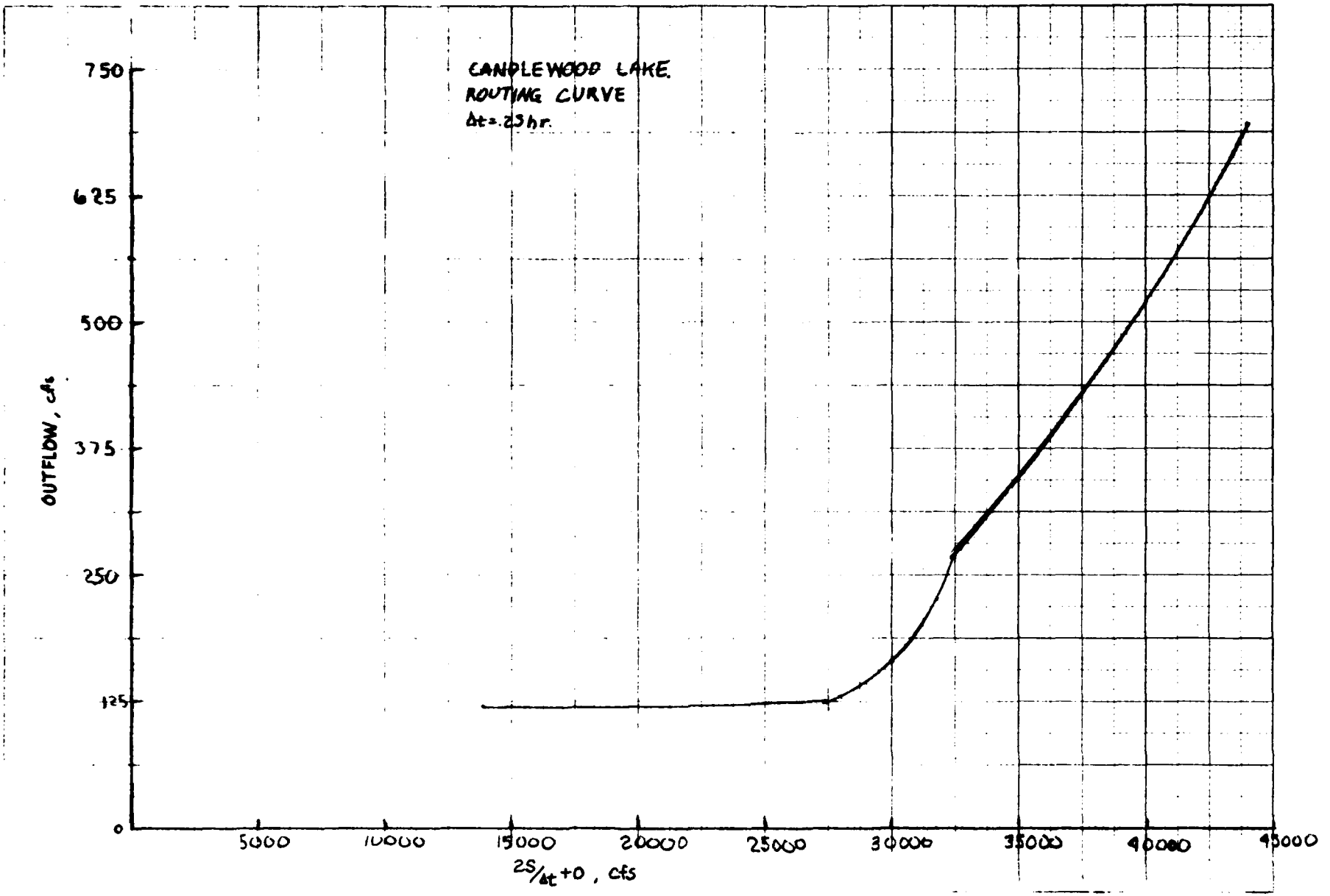
MIN QRF = .153 IN/day = 1.07 cfs

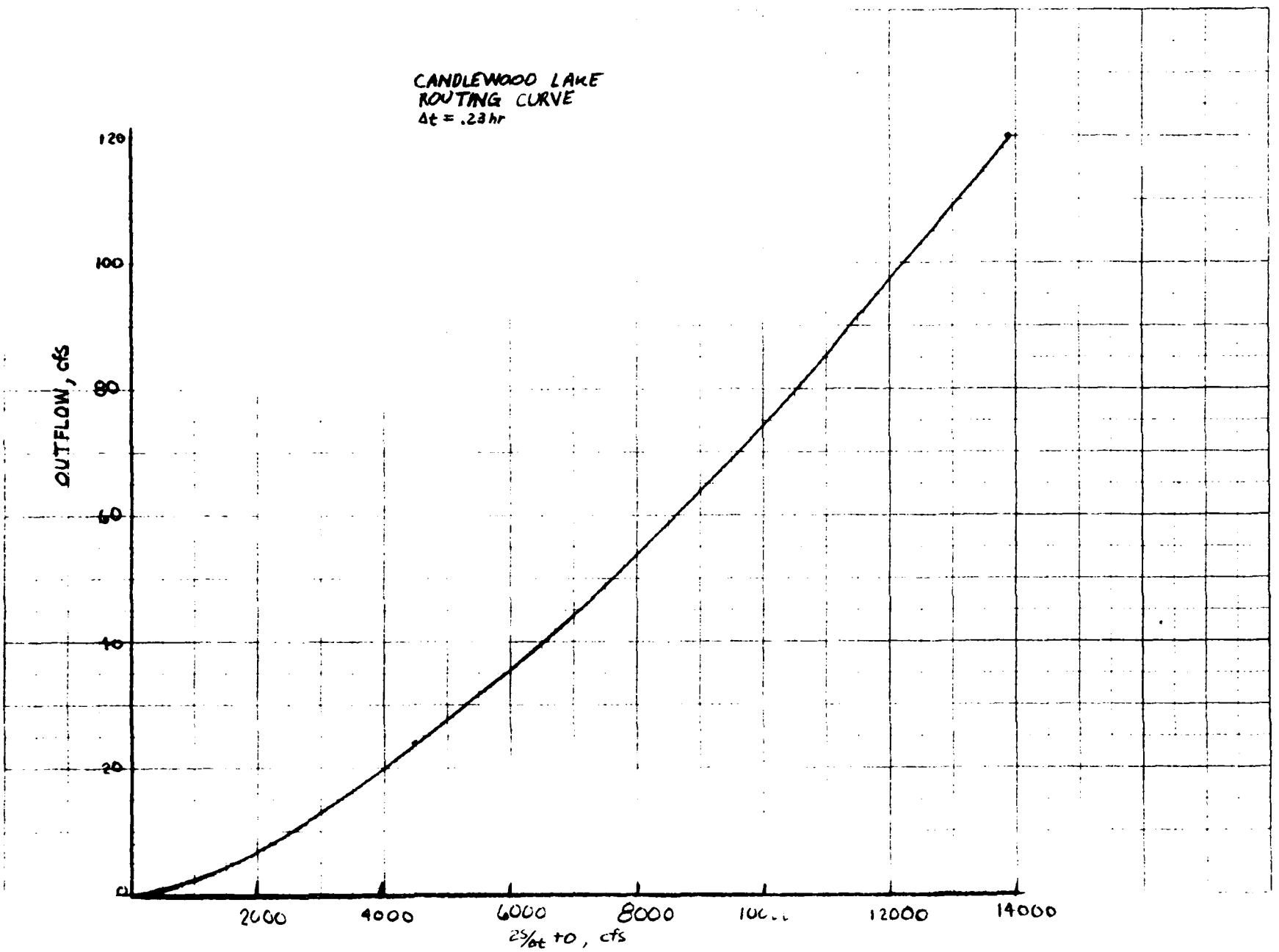
TIME(days)	PRELIMINARY PSH (cfs)	QRF (cfs)	PSH (cfs)	PRELIMINARY PSMC (INCHES)	ACC. QRF (INCHES)	PSMC (INCHES)
0	0	1.1	1.1	0	0	0
.1	1.3	1.1	2.4	.01	.02	.03
.5	1.7	1.1	2.8	.10	.08	.18
1.0	1.9	1.1	3.0	.23	.15	.38
2.0	2.3	1.1	3.4	.52	.31	.84
3.0	3.1	1.1	4.2	.91	.46	1.37
3.5	3.8	1.1	4.9	1.15	.54	1.69
4.0	5.1	1.1	6.2	1.50	.61	2.11
4.2	7.1	1.1	7.2	1.66	.64	2.30
4.4	8.6	1.1	9.7	1.87	.67	2.54
4.6	10.5	1.1	11.6	2.14	.70	2.84
4.7	12.6	1.1	13.7	2.30	.72	3.02
4.8	16.7	1.1	17.8	2.50	.73	3.23
4.9	25.7	1.1	26.8	2.79	.75	3.54
5.0	206.5	1.1	207.6	4.39	.77	5.16
5.1	79.6	1.1	80.7	6.36	.78	7.14
5.2	32.7	1.1	33.8	7.14	.80	7.94
5.3	18.1	1.1	19.2	7.49	.81	8.30
5.4	12.9	1.1	14.0	7.70	.83	8.53
5.5	10.4	1.1	11.5	7.86	.84	8.70
5.6	7.6	1.1	8.7	7.99	.86	8.85
5.8	6.5	1.1	7.6	8.18	.89	9.07
6.0	5.1	1.1	6.2	8.34	.92	9.26
6.5	4.3	1.1	5.4	8.64	.99	9.65
7.0	3.4	1.1	4.5	8.88	1.07	9.95
8.0	2.3	1.1	3.4	9.25	1.22	10.47
9.0	1.8	1.1	2.9	9.53	1.38	10.91
10.0	1.5	1.1	2.6	9.74	1.53	11.27
10.1	.1	1.1	1.2	9.76	1.55	11.31


CANDLEWOOD LAKE
100YR. PSMC ROUTING
STORM PASSES WITH NO FLOW IN THE E.S.
VOLUME IN INCHES
0
1
2
3
4
5
6
7
8
9
10
0
1
2
3
4
5
6
7
8
9
TIME, DAYS.




CANDLEWOOD LAKE
INFLOW HYDROGRAPH
AMC III P100
INFLOW, cfs
0
100
200
300
400
500
600
700
1
2
3
4
5
6
TIME, HOURS




CANDLEWOOD LAKE
ROUTING CURVE
Δt = .23 hr
OUTFLOW, cfs
120
100
80
60
40
20
0
2000
4000
6000
8000
10000
12000
14000
2S/Δt + O, cfs

CANDLEWOOD LAKE ROUTING, AMC II PMF gem.

TIME hr	INFLOW (cfs)	$2S/\Delta t - O$ (cfs)	$2S/\Delta t + O$ (cfs)	OUTFLOW (cfs)	
0	0	0		0	
.23	56	56	56	0	
.46	154	266	266	0	
.70	252	670	672	1	
.93	350	1266	1272	3	
1.16	448	2050	2064	7	
1.39	570	3042	3068	13	
1.62	769	4335	4381	23	
1.86	1715	6733	6819	43	
2.09	3647	11877	12095	109	
2.32	2792	18076	18316	120	
2.55	1501	22125	22369	122	
2.78	1059	24437	24685	124	
3.02	881	26127	26377	125	
3.25	754	27503	27762	127	
3.48	650	28624	28912	144	
3.71	570	29518	29884	163	
3.94	510	30238	30598	180	
4.18	472	30818	31220	201	
4.41	445	31283	31735	226	
4.64	430	31658	32158	250	
4.87	415	31959	32503	272	
5.10	404	32222	32778	278	
5.34	389	32439	33015	288	
5.57	371	32611	33199	294	
5.80	365	32747	33347	300	PEAK OUTFLOW
6.03	41	32577	33159	291	ELEV ~ 530 ft MSL
6.26	0		32624	275	

CANDLEWOOD LAKE P100 AMC III HYDROGRAPH

HYDROGRAPH FAMILY # 1 $T_3/T_p = 75$

$T_p = .074$ $Q_{gp} = 7993$ cfs

LINE No.	t/T_p	t (hrs)	q_c/q_p	q_c (cfs)
1	0	0	0	0
2	3.00	.22	.0017	14
3	6.00	.44	.0039	31
4	9.00	.67	.0054	43
5	12.00	.89	.0084	67
6	15.00	1.11	.0106	85
7	18.00	1.33	.0137	110
8	21.00	1.55	.0197	157
9	24.00	1.78	.0516	412
10	27.00	2.00	.0900	719
11	30.00	2.22	.0593	474
12	33.00	2.44	.0321	257
13	36.00	2.66	.0226	181
14	39.00	2.89	.0188	150
15	42.00	3.11	.0161	129
16	45.00	3.33	.0142	114
17	48.00	3.55	.0125	100
18	51.00	3.77	.0112	90
19	54.00	4.00	.0105	84
20	57.00	4.22	.0100	80
21	60.00	4.44	.0097	78
22	63.00	4.66	.0094	75
23	66.00	4.88	.0090	72
24	69.00	5.11	.0087	70
25	72.00	5.33	.0084	67
26	75.00	5.55	.0081	65
27	78.00	5.77	.0002	2
28	81.00	5.99	0	0

CANDLEWOOD LAKE | PMF AMC II HYDROGRAPH

gen.

HYDROGRAPH FAMILY # 1 $T_o/T_p = 50$

$T_p = .116$ hr $Q_{gp} = 29673$ cfs

LINE NO	t/T_p	t (hrs)	Q_c/Q_p	Q_c (cfs)
1	0	0	0	0
2	2.00	.23	.0019	56
3	4.00	.46	.0052	154
4	6.00	.70	.0085	252
5	8.00	.93	.0118	350
6	10.00	1.16	.0151	448
7	12.00	1.39	.0192	570
8	14.00	1.62	.0259	769
9	16.00	1.86	.0578	1715
10	18.00	2.09	.1330	3947
11	20.00	2.32	.0941	2792
12	22.00	2.55	.0506	1501
13	24.00	2.78	.0357	1059
14	26.00	3.02	.0297	881
15	28.00	3.25	.0254	754
16	30.00	3.48	.0219	650
17	32.00	3.71	.0192	570
18	34.00	3.94	.0172	510
19	36.00	4.18	.0159	472
20	38.00	4.41	.0150	445
21	40.00	4.64	.0145	430
22	42.00	4.87	.0140	415
23	44.00	5.10	.0136	404
24	46.00	5.34	.0131	389
25	48.00	5.57	.0125	371
26	50.00	5.80	.0123	365
27	52.00	6.03	.0016	47
28	54.00	6.26	0	0

SPILLWAY RATING +

CANDLEWOOD LAKE ROUTING CURVE COMPUTATION

gam.

ELEVATION	SERVICE SPILLWAY				EMERGENCY SPILLWAY		TOTAL OUTFLOW
	WEIR FLOW		PIPE FLOW				
Ft MSL	h(ft)	Q(cfs)	h(ft)	Q cfs	H_m(ft)	Q(cfs)	Q_T(cfs)
523.2	0	0					0
523.7	.5	8.4	32.3	116.4			8
524.2	1.0	23.7	32.8	117.3			24
526.2	3.0	123.2	34.8	120.0			120
528.9	(T=0)		37.5	125.4	0	0	125
529.4	(T=55)		38.0	126.3	.5	39.0	165
529.9	(T=70)		38.5	127.1	1.0	140.4	268
531.9	(T=100)		40.5	130.4	2.0	562.1	693
533.9	(T=120)		42.5	133.5	4.0	1934.8	1967
5350	(T=150)		43.6	135.3	6.1	4531.1	4666

PS WEIR FLOW $Q = CLH^{3/2}$ $C = 3.02$ $L = \pi(2.5)$

PS PIPE FLOW $Q = Ca\sqrt{2gh}$ $C = .52$ $a = \frac{\pi}{4}(2.5)^2$

ES. $Q = 2.005\ T\ H_m^{3/2}$

h(Ft)	STORAGE (Ac-ft)	STORAGE (CF)	$\Delta S/\Delta t$ (.234 cfs)	OUTFLOW (cfs)	$2S/\Delta t + O$ (cfs)
0	0	0	C	0	0
.5	21.2	10.7	1106	9	2219
1.0	42.7	21.5	2227	24	4478
3.0	132.0	66.5	6884	120	13889
5.7	260.8	131.5	13602	125	27329
6.2	285.8	144.1	14906	165	29976
6.7	308.9	155.7	16064	268	32395
8.7	415.4	209.4	21665	698	44028
10.7	524.8	264.6	27371	1967	56708
11.8	587.6	296.2	30646	4663	65952

APPENDIX F

CORRESPONDENCE

Date 2/14/79 Region West

INSPECTION REPORT

Name of Dam: Candlewood County: Hardeman

Owner's Name: _____ Quad: 432SE

Type Project: Application No. 76-115-0

Existing	X
New Construction	
Repair/Alteration	
Removal	

Type Inspection:

Phase I		Phase I Reconnaissance _____
Phase II		
Certificate	X	
Cursory		
Preliminary Site Review		

Damage Potential Category: One ___ Two ___ Three ___ Undetermined ___

Inspection by: George Moore and Troy Wedekind

Inspection Results:

The dam has numerous small erosion gullies both upstream and downstream. The erosion gullies should be repaired along with reseeding of the slopes to establish adequate cover to prevent further erosion. The exit channel of the emergency spillway has no cover. A grass cover should be established to allow safe operation of the emergency spillway. No wetland vegetation was observed downstream that would indicate seepage or leaks. This report is accompanied by a photo.

RAM 1/14

~~EPD~~

Send copy to George

File

CANDLEWOOD LAKES PROPERTY

OWNERS ASSOC.,INC.

P.O. BOX 171321
MEMPHIS,TN. 38117

December 31, 1980

Mr. Robert A. Hunt, Director
Division of Water Resources
Tennessee Department of Conservation
4721 Trousdale Drive
Nashville, Tennessee 37219

Re: Dams at Candlewood Lake, Spring Lake #2, Crystal Lake #4 and Old Hickory Lake located in Hardeman County

Dear Mr. Hunt:

Your letter of December 1, 1980 to Candlewood Lakes Inc., has been forwarded to us.

As of January 1, 1979, the ownership of the above mentioned dams was transferred to Candlewood Lakes Property Owners Association.

We were not aware of the State Safe Dams Act, but we will be glad to cooperate with you in any way possible to keep the dams safe.

Please direct all future correspondence to Candlewood Lakes Property Owners Association, P.O. Box 171321, Memphis, Tennessee 38117. The phone number is 901-685-6968.

Sincerely,

W. J. Arnold, President
Candlewood Lakes Property Owners Assn.

WJA/a

PHOTO NO. 1

14 Feb 79 Candlewood Dam Hardeman Co.

Outlet channel of the emergency spillway showing the lack of ground cover.

Tennessee Department of
Conservation Division of Water Resources
RAY BLANTON - GOVERNOR
B.R.ALLISON - COMMISSIONER
6213 Charlotte Ave(Suite 107) Nashville,Tennessee 37209 (615)741-1281
ROBERT A. HUNT DIRECTOR

October 25, 1976

Mr. Wayne L. Smith, Vice-President
Candlewood Lakes Corporation
P. O. Box 17762
Memphis, Tennessee 38117

Re: Certificate of Approval and Safety
Application No. 76-115-0, Candlewood Dam

Dear Mr. Smith:

Enclosed please find Certificate of Approval and Safety issued Candlewood Lakes Corporation for operation of the above referenced project. This Certificate is issued for a period of twelve (12) months and is due to expire on October 14, 1977.

The project will be scheduled for a safety inspection by our Division at a time interval of approximately one year. You will be further notified prior to the inspection.

Enclosed for your information is a pamphlet regarding inspection and maintenance of privately owned dams. You are requested to properly maintain the scructure and periodically perform routine inspection in accordance with the guidelines furnished in the pamphlet. Should a problem develop please notify our office immediately.

Your cooperation with the safe dams program is appreciated. If we can be of assistance at any time, please let us know.

Very truly yours,

Robert A. Hunt
Director

copy to: Ragon Engineering Company

Edmond B. O'Neill, Regional Engr. ✓
Division of Water Resources

Encl. (2)

RAGON ENGINEERING COMPANY

CONSULTING ENGINEERS
735 WEST MARKET ST.
P. O. Box 367
BOLIVAR, TENNESSEE 38008

August 16, 1976

JAMES H. RAGON, P. E.

DON R. MOORE, BSCE; EIT
EDMOND B. O'NEILL, BSME
BOBBY L. TULLEY, BSAET

Mr. Robert A. Hunt
Tennessee Department of Conservation
Division of Water Resources
6213 Charlotte Ave.
General Care Bldg., Suite #107
Nashville, Tennessee 37209

Re: Candlewood Subdivision
Candlewood Lake (Lake #1)

Dear Mr. Hunt:

The Construction of Candlewood Lake has been completed and was done in substantial comformity with the approved plans and specifications as prepared by Ragon Engineering Company.

Yours truly,

James H. Ragon

James H. Ragon, P.E.

JHR/ct

Enc.

cc: Mr. Edmond B. O'Neill
Regional Engineer

S & W Construction Company
Memphis, Tennessee

ORNED-G

NON-FEDERAL DAM INSPECTION REVIEW BOARD
PO BOX 1070
NASHVILLE, TENNESSEE 37202

Commander, Nashville District
US Army, Corps of Engineers
PO Box 1070
Nashville, TN 37202

1. The Interagency Review Board, appointed by the Commander on 8 October 1980, presents the following recommendations after meeting on 18 June 1981 to consider the Phase I investigation report on Candlewood Lake Dam inspected by the Tennessee Department of Conservation.

2. The condition classification should be changed from "deficient" to "significantly deficient."

3. Removal of material in the emergency spillway by mechanical means should not be allowed to continue.

4. The reason for the discontinuity on the embankment slope should be determined and included in the report.

5. An emergency action plan should be developed, including a warning system to alert downstream residents, in the event a serious condition develops with the project.

6. The owner should establish a regular program of inspection and maintenance to provide detection and timely correction of problem areas.

7. The Board is in agreement with other report conclusions and recommendations following minor revisions.

Herman Gray
HERMAN GRAY
Chief, Design Branch
Alternate Chairman

Bobby G. Moore
BOBBY G. MOORE
Assistant State Conservation Engineer
Alternate, Soil Conservation Service

Robert A. Hunt
ROBERT A. HUNT
Director, Division of Water Resources
State of Tennessee

Thomas N. Porter
THOMAS N. PORTER
Hydraulic Engineer
Alternate, Hydrology and Hydraulics Branch

Edward B. Boyd
EDWARD B. BOYD
Hydrologic Technician
Alternate, US Geological Survey

Timothy McCleskey
TIMOTHY MCCLESKEY
Chief, Instrumentation and Inspection Section
Alternate, Geotechnical Branch

APPENDIX G

DESIGN AND CONSTRUCTION DATA

PLANS

FOR

CANDLEWOOD LAKE (LAKE NO. 1)

HARDEMAN COUNTY, TENNESSEE

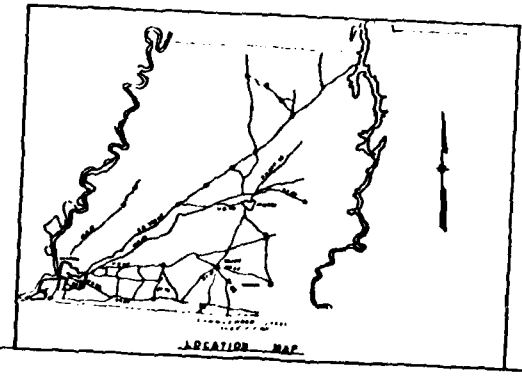
CANDLEWOOD LAKES INCORPORATED

RANDOLPH E. HOLT

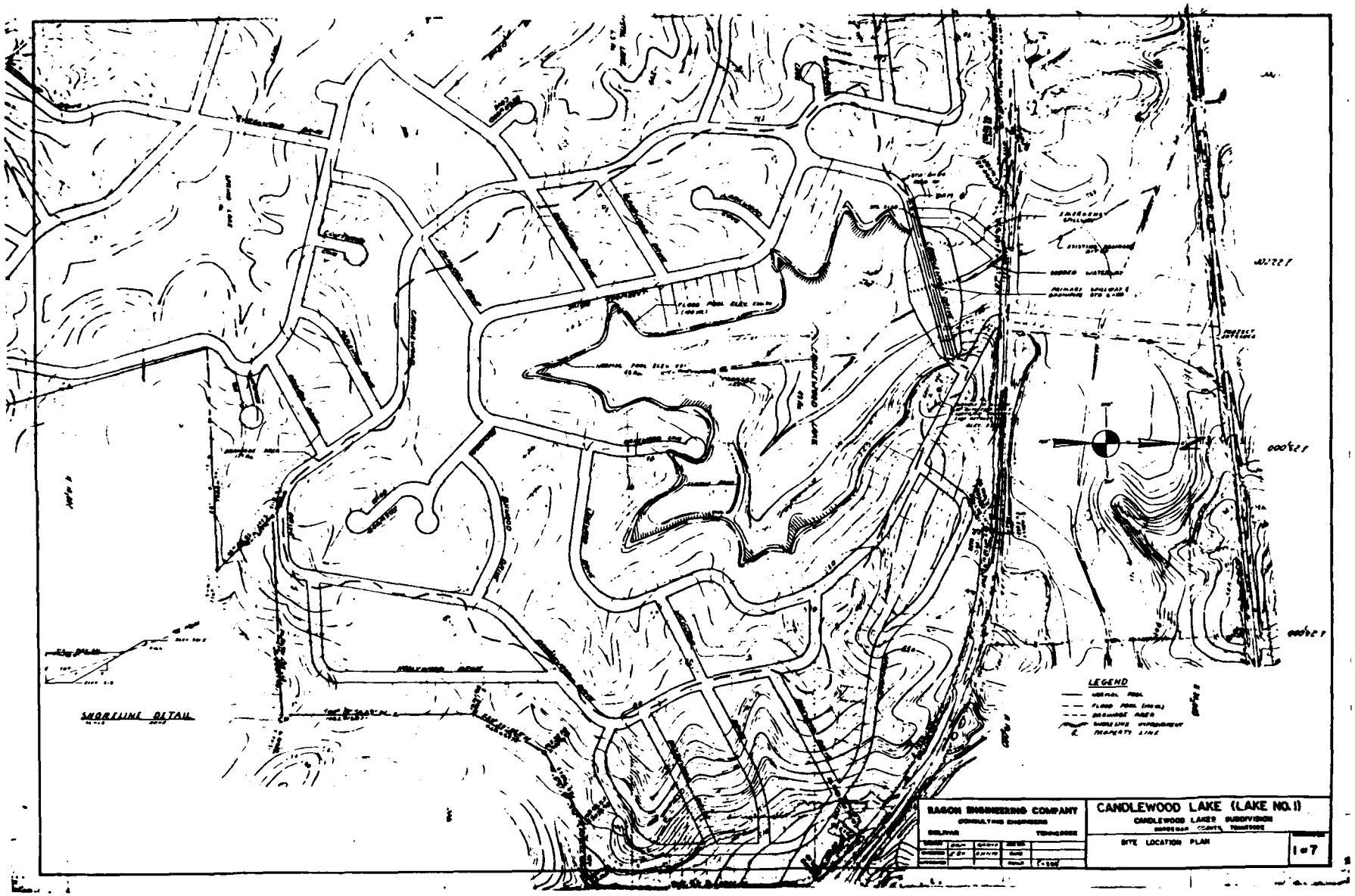
DEVELOPER

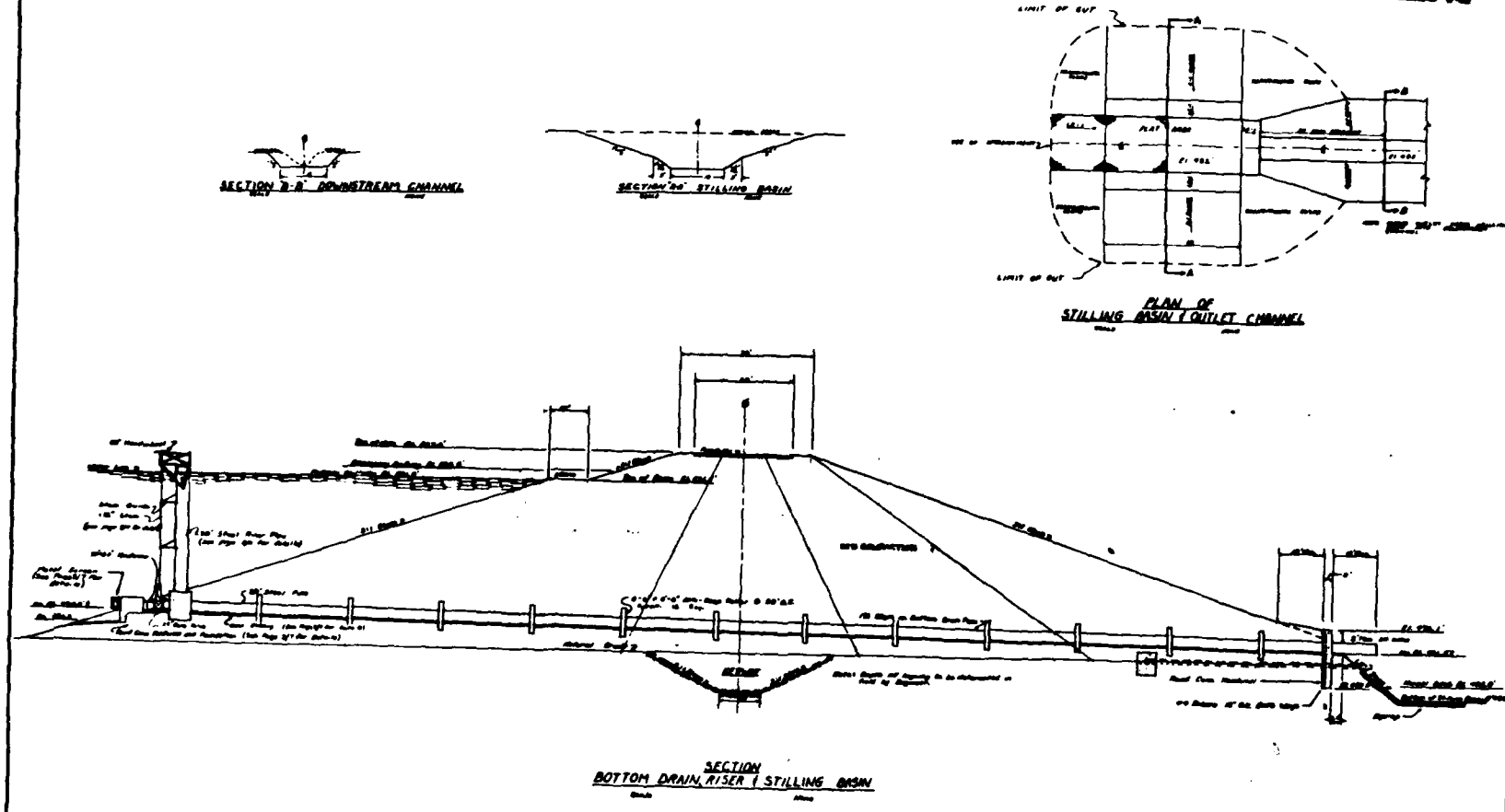
RAGON ENGINEERING COMPANY

BOLIVAR, TENNESSEE

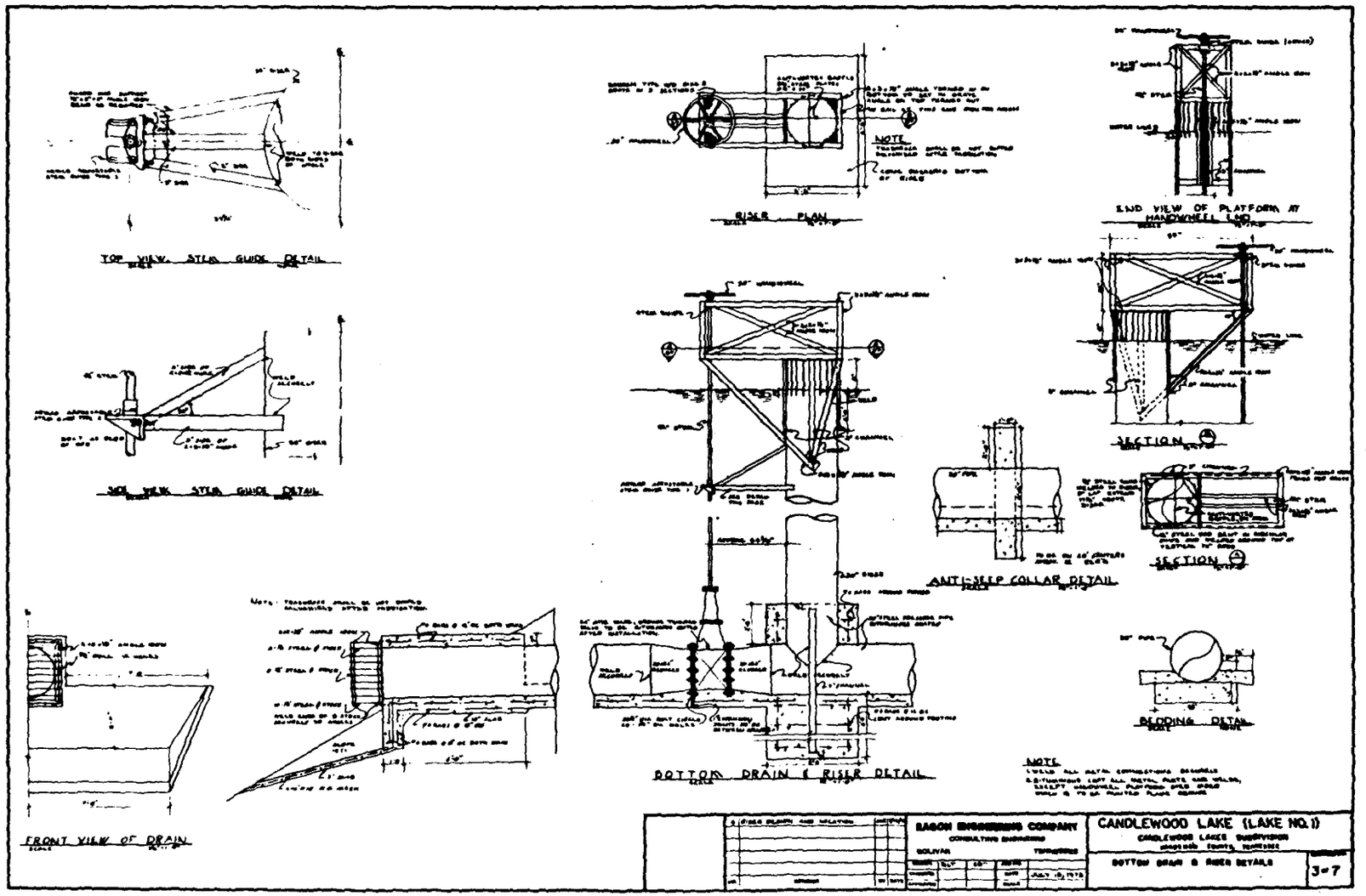


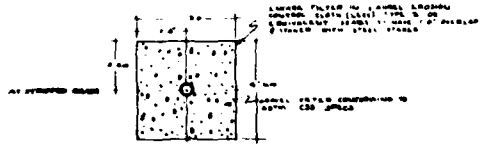
LOCATION MAP


SHORELINE DETAIL
LEGEND
RAGON ENGINEERING COMPANY
CONSULTING ENGINEERS
CANDLEWOOD LAKE (LAKE NO. 1)
CANDLEWOOD LAKES SUBDIVISION
SITE LOCATION PLAN
1 of 7

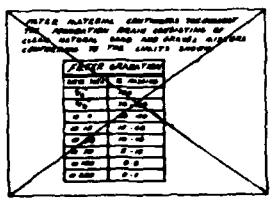


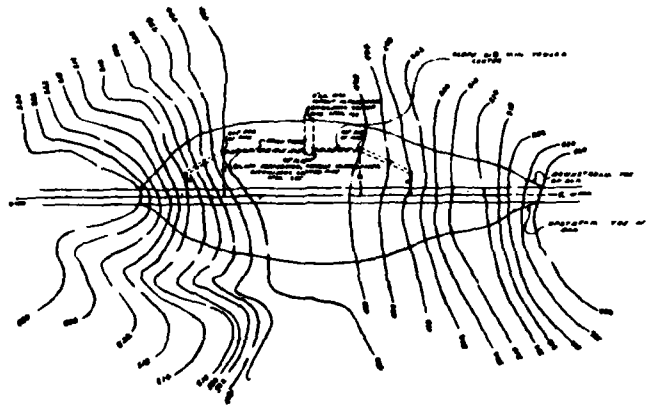
		BASON ENGINEERING COMPANY	CANDLEWOOD LAKE (LAKE NO. 1)	
			GENERAL ARRANGEMENT DRAINAGE, RISER, VALVE, AND STILLING BASIN	2 OF 7


TOP VIEW STEM GUIDE DETAIL
SIDE VIEW STEM GUIDE DETAIL
RISER PLAN
NOTE
END VIEW OF PLATFORM AT HANDWHEEL END
SECTION
SECTION
ANTI-SEEP COLLAR DETAIL
BEDDING DETAIL
BOTTOM DRAIN & RISER DETAIL
FRONT VIEW OF DRAIN
NOTE
BAGBY ENGINEERING COMPANY
CONSULTING ENGINEERING
BOLIVAR TENNESSEE
CANDLEWOOD LAKE (LAKE NO. 1)
CANDLEWOOD LAKES SUBDIVISION
BOTTOM DRAIN & RISER DETAILS
3-7

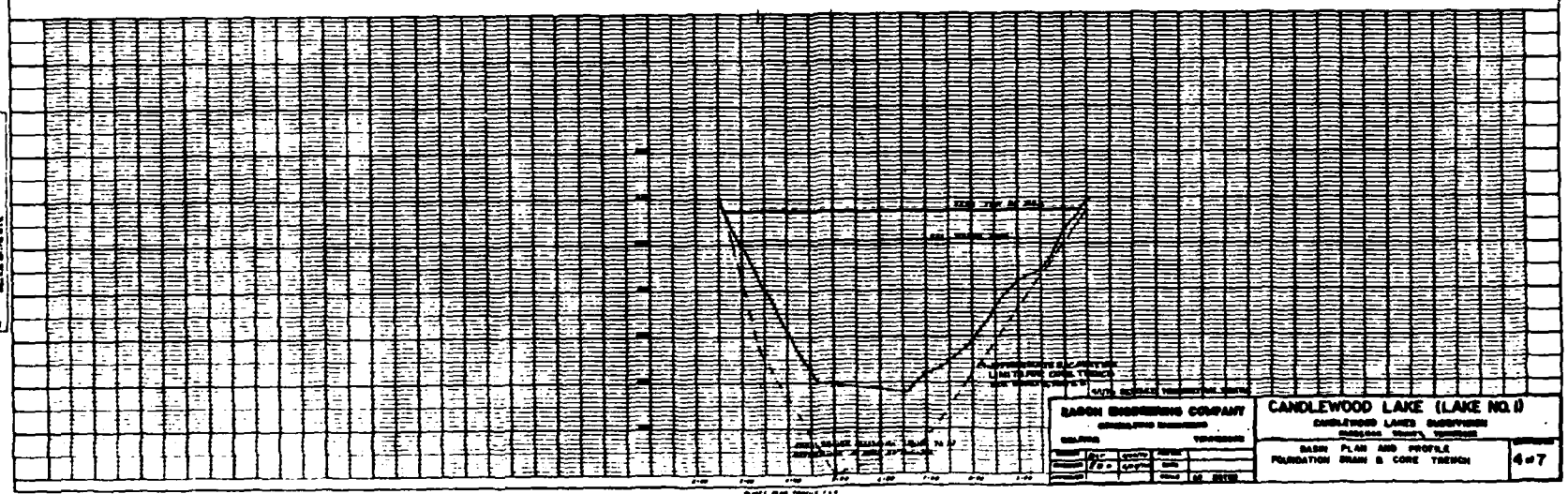


FOUNDATION DRAIN FILTER DETAIL





FOUNDATION DRAIN PLAN



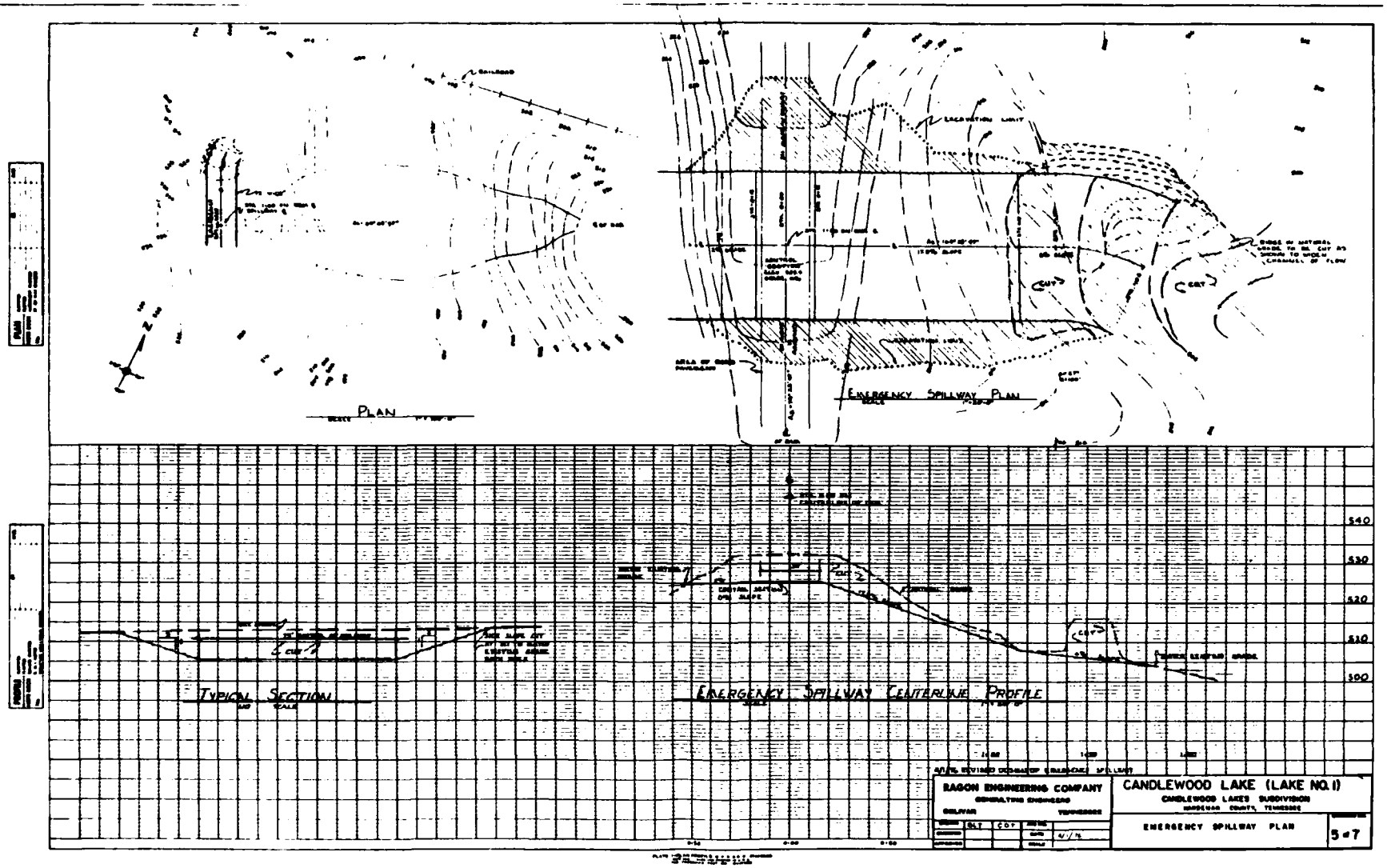
BASIN ENGINEERING COMPANY

CANDLEWOOD LAKE (LAKE NO. I)

CANDLEWOOD LAKES SUBDIVISION

BASIN PLAN AND PROFILE
FOUNDATION DRAIN & CORE TRENCH

4 of 7

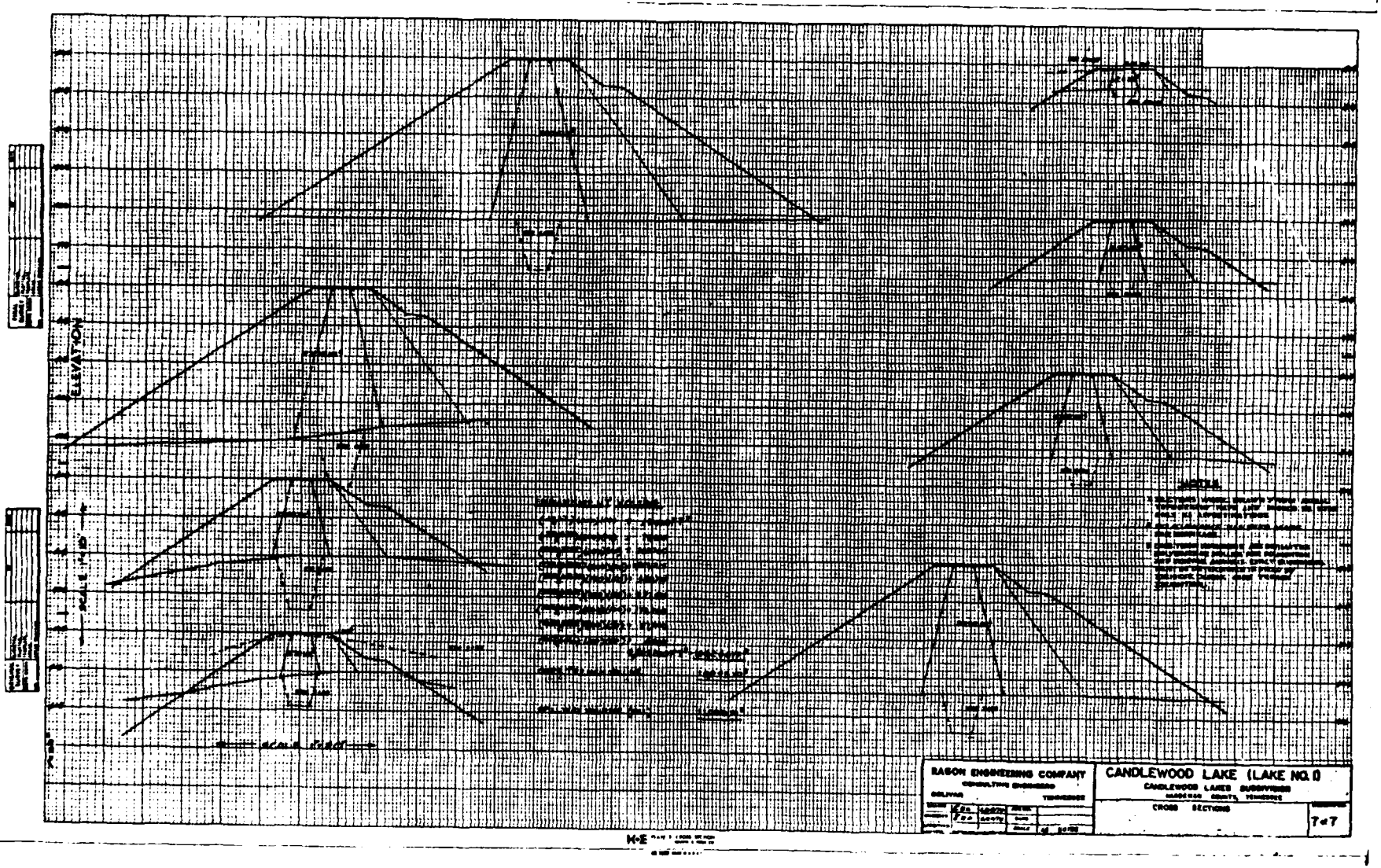


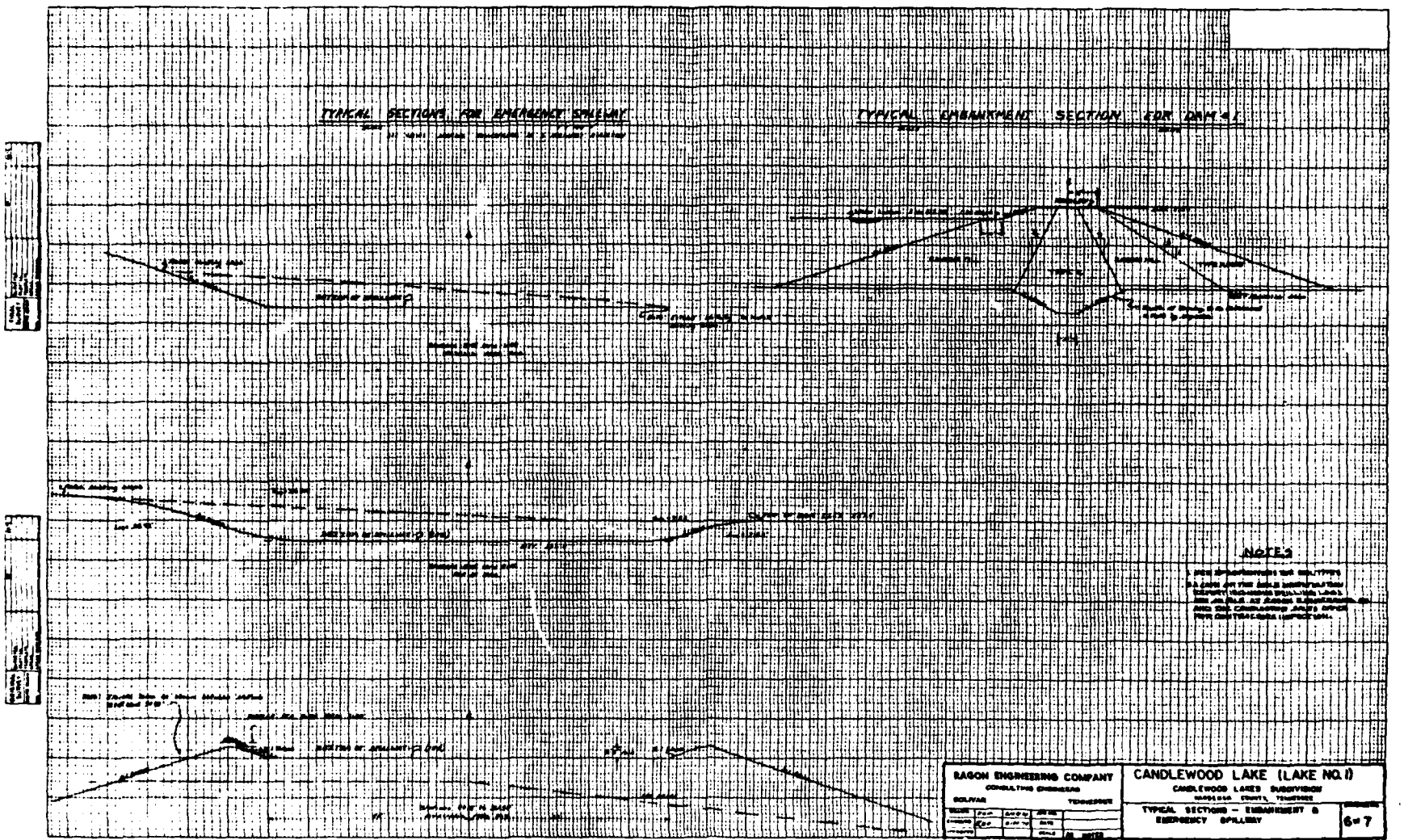
RAGON ENGINEERING COMPANY
CONSULTING ENGINEERS
OBLIVAR TENNESSEE

CANDLEWOOD LAKE (LAKE NO. 1)
CANDLEWOOD LAKES SUBDIVISION
HARDEMAN COUNTY, TENNESSEE

EMERGENCY SPILLWAY PLAN

5 of 7


ELEVATION
BASON ENGINEERING COMPANY
CONSULTING ENGINEERS
CANDLEWOOD LAKE (LAKE NO. 1)
CANDLEWOOD LAKES SUBDIVISION
CROSS SECTIONS
7 of 7


TYPICAL SECTIONS FOR EMERGENCY SPILLWAY
TYPICAL EMBANKMENT SECTION FOR DAM # 1
NOTES
RAGON ENGINEERING COMPANY
CONSULTING ENGINEERS
BOLIVAR TENNESSEE
CANDLEWOOD LAKE (LAKE NO. 1)
CANDLEWOOD LAKES SUBDIVISION
TYPICAL SECTIONS – EMBANKMENT & EMERGENCY SPILLWAY
6 of 7

CML

ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor _____ Project [illegible]

Report to Mr. Randy Holt; Mr. Ed O'Neil Date September 19, 1974

Lab. No. 24534

Test No.	1					
Density of Sand (lbs./cu. ft.)	98.0					
Wgt. of Jar & Sand (before test)	7.36					
Wgt. of Jar & Sand (after test)	3.06					
Wgt. of Sand in Hole & Funnel	4.30					
Wgt. of Sand in Funnel	1.90					
Wgt. of Sand in Hole	2.40					
Volume of Hole (cu. ft.)	.0245					
Wgt. of Wet Soil	3.25					
Wgt. of Dry Soil	2.88					
Wgt of Water	.37					
Moisture Content (% of Dry Wgt.)	12.8					
Density, Dry Soil (lbs./cu. ft.)	117.5					
% Required Density	104.4					
Required Density (lbs./cu. ft.)	112.5					
Optimum Moisture (% of Dry Wgt.)	14.6					
Stone, % by Wgt.						

Location of Tests

1 [illegible]' L. in Center of Dam

40 OLD HICKORY COVE JACKSON, TENNESSEE 38301
(901) 424-2545

CML

ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor Randy Holt Project CANDLEWOOD

Report to Mr. Randy Holt; Mr. Ed O'Neil Date September 17, 1974

Lab. No. 24504

Test No.	1					
Density of Sand (lbs./cu. ft.)	98.0					
Wgt. of Jar & Sand (before test)	7.92					
Wgt. of Jar & Sand (after test)	3.77					
Wgt. of Sand in Hole & Funnel	4.15					
Wgt. of Sand in Funnel	1.90					
Wgt. of Sand in Hole	2.25					
Volume of Hole (cu. ft.)	.0230					
Wgt. of Wet Soil	2.98					
Wgt. of Dry Soil	2.57					
Wgt. of Water	.41					
Moisture Content (% of Dry Wgt.)	16.0					
Density, Dry Soil (lbs./cu. ft.)	111.7					
% Required Density	99.3					
Required Density (lbs./cu. ft.)	112.5					
Optimum Moisture (% of Dry Wgt.)	14.6					
Stone, % by Wgt.						

Location of Tests

1 Center of Dam, 100' E. from Ditch

40 OLD HICKORY COVE JACKSON, TENNESSEE 38301
(901) 424-2545

CML

Construction Materials Laboratory

Analysis MOISTURE DENSITY TEST (Proctor)
From:
Contractor:
Producer:
Report To: Mr. Randy Holt; Mr. Ed O'Neil

Project: CANDLEWOOD DEVELOPMENT
Date: September 19, 1974
Lab. No.: 24535

Test No.	1	2	3					
Wt. of Mold	4.49	4.49	4.49					
Wt. Mold & Wet Soil	8.42	8.78	8.68					
Wt. Wet Soil	[illegible]	4.29	4.19					
Density Wet Soil lbs./cu. ft.	117.9	128.7	[illegible]					
Wt. Pan & Wet Soil	180.0	180.0	180.0					
Wt. Pan & Dry Soil	163.6	159.2	154.1					
Wt. of Water	16.4	20.8	25.9					
Wt. Pan	15.1	15.3	15.8					
Wt. of Dry Soil	148.5	143.9	138.3					
Moisture Content % Dry Soil	11.0%	14.5%	18.7%					
Density Dry Soil lbs./cu. ft.	106.2	112.4	105.9					

Remarks: Light Tan Sandy Silt (STANDARD)

Maximum Density, Dry soil (Lbs./cu.ft.) 112.5

Optimum Moisture Content (% of Dry Weight) 14.6%

Location of Tests: Taken from the core area

40 OLD HICKORY COVE JACKSON, TENNESSEE 38301
(901) 424-2648

CML

ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor _____ Project CANDLEWOOD DEVELOPMENT

Report to Mr. Randy Holt; Mr. Ed O'Neil Date October 10, 1974

Lab. No. 24762

Test No.	1	2				
Density of Sand (lbs./cu. ft.)	98.0	98.0				
Wgt. of Jar & Sand (before test)	7.80	7.59				
Wgt. of Jar & Sand (after test)	3.42	3.22				
Wgt. of Sand in Hole & Funnel	4.38	4.37				
Wgt. of Sand in Funnel	1.90	1.90				
Wgt. of Sand in Hole	2.48	2.47				
Volume of Hole (cu. ft.)	.0253	.0252				
Wgt. of Wet Soil	3.27	3.32				
Wgt. of Dry Soil	2.78	2.83				
Wgt. of Water	.49	.49				
Moisture Content (% of Dry Wgt.)	17.6	17.3				
Density, Dry Soil (lbs./cu. ft.)	109.9	112.3				
% Required Density	97.7	99.8				
Required Density (lbs./cu. ft.)	112.5	112.5				
Optimum Moisture (% of Dry Wgt.)	14.6	14.6				
Stone, % by Wgt.						

Location of Tests

1 350' W. in Center of Dam
2 250' W. in Center of Dam

40 OLD HICKORY COVE JACKSON, TENNESSEE 38301
(901) 424-2545

CML

Construction Materials Laboratory

Analysis MOISTURE DENSITY TEST (Proctor)

From:
Contractor:
Producer:
Report To: Mr. Ran[illegible]

Project: CANDLEWOOD DEVELOPMENT
Date: October 15, 1974
Lab. No.: 24812

Test No.	1	2	3	4	5			
Wt. of Mold	4.49	4.49	4.49	4.49	4.49			
Wt. Mold & Wet Soil	[illegible]	[illegible]	8.56	8.67	8.57			
Wt. Wet Soil	[illegible]	3.97	4.07	4.18	4.08			
Density Wet Soil lbs./cu. ft.	[illegible]	119.1	122.1	125.4	122.4			
Wt. Pan & Wet Soil	180.0	180.0	180.0	180.0	180.0			
Wt. Pan & Dry Soil	161.7	164.9	160.7	158.2	152.6			
Wt. of Water	18.3	15.1	19.3	21.8	27.4			
Wt. Pan	15.6	15.1	15.8	15.8	15.5			
Wt. of Dry Soil	154.1	149.8	144.9	142.4	137.1			
Moisture Content % Dry Soil	6.7	10.1	13.3	17.8	20.0			
Density Dry Soil lbs./cu. ft.	[illegible]	[illegible]	107.8	106.5	102.0			

Remarks:
Brown and gray clayey silt (STANDARD)

Maximum Density, Dry soil (Lbs./cu.ft.) 108.9

Optimum Moisture Content (% of Dry Weight) 14.0%

Location of Tests:
taken from core fill

40 OLD HICKORY COVE JACKSON, TENNESSEE 38301
(901) 424-2545

CML

Construction Materials Laboratory

DAVID M. EVANS, P.E.

Project CANEWOOD DEVELOPMENT
Date October 16, 1974
Lab. No. 24833

Analysis of Soil Classification
Received from
Contractor
Producer
Reported To Mr. Randy Holt; Mr. Ed O'Neil

SAMPLE: Silty Clay with Fine Sand

LOCATION: West Core

PASSING	RETAINED ON	PERCENT	CHARACTERISTICS
3"	No. 10	0.0	Gravel
No. 10	No. 40	1.5	Coarse Sand
No. 40	No. 200	63.3	Fine Sand
No. 200	Pan	35.2	Combination Silt & Clay

Liquid Limit: 33

Plastic Limit: 23

P. I.: 10

Classification: CL

NOTE: Material should be satisfactory for cut-off as long as sand content does not increase

40 OLD HICKORY COVE JACKSON, TENNESSEE 38301
(901) 424-2545

CML

ANALYSES OF MOISTURE DENSITY TEST OF COMPACTED FILL

Contractor _____ Project [illegible]

Report to Mr. Randy Holt; Mr. Ed O'Neil Date October 28, 1974

Lab. No. 24961

Test No.	1	2	3			
Density of Sand (lbs./cu. ft.)	98.0	98.0	98.0			
Wgt. of Jar & Sand (before test)	7.77	7.70	7.63			
Wgt. of Jar & Sand (after test)	3.58	3.69	3.68			
Wgt. of Sand in Hole & Funnel	4.19	4.01	3.95			
Wgt. of Sand in Funnel	1.90	1.90	1.90			
Wgt. of Sand in Hole	2.29	2.11	2.05			
Volume of Hole (cu. ft.)	.02336	.0215	.0209			
Wgt. of Wet Soil	2.93	2.91	2.89			
Wgt. of Dry Soil	2.63	2.60	2.57			
Wgt. of Water	.30	.31	.32			
Moisture Content (% of Dry Wgt.)	11.4	11.9	12.5			
Density, Dry Soil (lbs./cu. ft.)	112.6	120.9	123.0			
% Required Density	100.0	96.0	97.7			
Required Density (lbs./cu. ft.)	112.5	125.9	125.9			
Optimum Moisture (% of Dry Wgt.)	14.6	8.6	8.6			
Stone, % by Wgt.						

Location of Tests

1 225' N. in Center of Dam
2 20' W. off Center of Dam, 275' N.
3 325' N. in Center of Dam

40 OLD HICKORY COVE JACKSON, TENNESSEE 38301
(901) 424-2546

Candlewood Lake No 1

Mar. 22, 1976

D/C EBO 4/1/76

Flood Routing

A. P = 29.5 Q = 26 "

DA = 171 Ac = 0.267 mi²

$T_c = \left[\frac{11.9\left(\frac{1700}{5200}\right)^3}{106}\right]^{0.385} = 0.116$

5. Family = I

6. T_o = 5.71 hr

7 $T_p = 0.7 T_c = 0.081$

8 $T_o/T_p = \frac{5.71}{0.081} = 70.5$

9 T_o/T_p (Rev) = .75

10. T_p (Rev) = $\frac{5.71}{75}$ = 0.076 hr.

11 $q_p = \frac{484A}{T_p} = \frac{484(0.267)}{0.076} = 1701.56$ ft³/sec/in

12. $Q_{qp} = Q \times q_p = 26(1701.56) = 44241$ ft³/sec

13 $Q_1 = 0.09(44241) = 3982$ ft³/sec

14. $V_1 = 53.33(26)(0.267) = 370.2$ AF = 16.13×10^6 ft³

L_{cm} = 525.4'

15 $V_{Of} = 25 \times 10^6$ ft³

16 $V_{sp} = V_{ee} - V_{Of} = (34 - 25)10^6 = 9 \times 10^6$ ft³

17. $\frac{V_{sf}}{V_1} = \frac{9 \times 10^6}{16.13 \times 10^6} = 0.56$

B P = 12 Q = 9.5"

N_p = 521

$V_{NP} = 25 \times 10^6$ ft³

$V_{PMF} = \cancel{135 \times 5.9 \times 10^6}$

$V_{PMF} = \cancel{34.9 \times 10^6}$ 30.9×10^6 ft³

$E_{APMF} = \cancel{625.4}$ 524

RECEIVED
APR 5 1976
DEPT. OF CONSERVATION
WATER RESOURCES

C. P = 5.5, Q = 3.3 100 YR STORM

$171(43560)\frac{3.3}{12} = 2.05 \times 10^6$ ft³

9. $T_c/T_p(Rev) = .75$

10. $T_p(Rev) = \frac{5.71}{75} = 0.076$ hr.

11. $q_p = \frac{484A}{T_p} = \frac{484(0.267)}{0.076} = 1701.56$ ft³/sec/in

12. $Q_{qp} = Q \times q_p = 26(1701.56) = 44241$ ft³/sec

13. $Q_1 = 0.09(44241) = 3982$ ft³/sec

14. $V_1 = 53.33(26 X 0.267) = 370.2$ AF $= 16.13 \times 10^6$ ft³

$L_{510} = 525.4'$ Est Assumed

15. $V_{US} = 25 \times 10^6$ ft³

16. $V_{SP} = V_{EP} - V_{US} = (34 - 25)10^6 = 9 \times 10^6$ ft³

17. $\frac{V_{SP}}{V_1} = \frac{9 \times 10^6}{16.13 \times 10^6} = 0.56$

B. $P = 12$ $Q = 9.5$"

$N_p = 521$

$V_{NP} = 25 \times 10^6$ ft³

$V_{100} = ~~135 \times~~ 5.8 \times 10^6$

$V_{NATURAL} = ~~34.9 \times 10^6~~ 30.9 \times 10^6$ ft³

$E_{NP100} = ~~525.7~~ 524$

C. $P = 5.5$, $Q = 3.3$ 100YR STORM

$171(43560)\frac{3.3}{12} = 2.05 \times 10^6$ ft³

$V_{NP} = 25 \times 10^6$ ft³

$V_{100} = \frac{2.05 \times 10^6}{27.05 \times 10^6}$ ft³

$E_{NP100} = 522$

Candlewood Lake

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3/22/76

d. Compute the available flood storage at E_h

$V_{sl} = V_{th} - V_{uf}$

e. Follow steps 1 through 5 of the procedure given under principal spillway corrections for two stage structures

4. Principal Spillway System Calculations:

E_e = 525.4 ft	z = ____ L = ____ ft	V_{sp}/V_I = 0.56
V_{te} = 34x10⁶ AF	Case ____ S_o = ____ %	$V_{sp}/V_I + V_{ol}/V_I$ = 0.56
V_{sp} = 9x10⁶ AF	Q_h = 102 cfs	V'_{sp}/V_I = 0.62
Q_{ph} = 113 cfs	Q_h/Q_I = 102/3982 = 0.026	V_{op}/V_I = 0.06

a. Select an elevation of emergency spillway crest, E_e

b. Read the total storage at E_e from the stage-storage curve, this is V_{te}

c. Compute the available flood storage at E_e
$V_{sp} = V_{te} - V_{uf}$

d. Obtain principal spillway discharge at E_e, this is Q_{ph}

e. Compute the average high stage release rate, this is Q_h

f. Follow the procedure given for single stage structures, or steps 6 through 10 for two stage structures, principal spillway corrections

g. Compute the principal spillway correction

$V_{op}/V_I = V'_{sp}/V_I - V_{sp}/V_I$

h. Obtain from the emergency spillway layout data

(1) Entrance Length, L

(2 [illegible]rofile [illegible]ase

([illegible] [illegible]lope, S_o

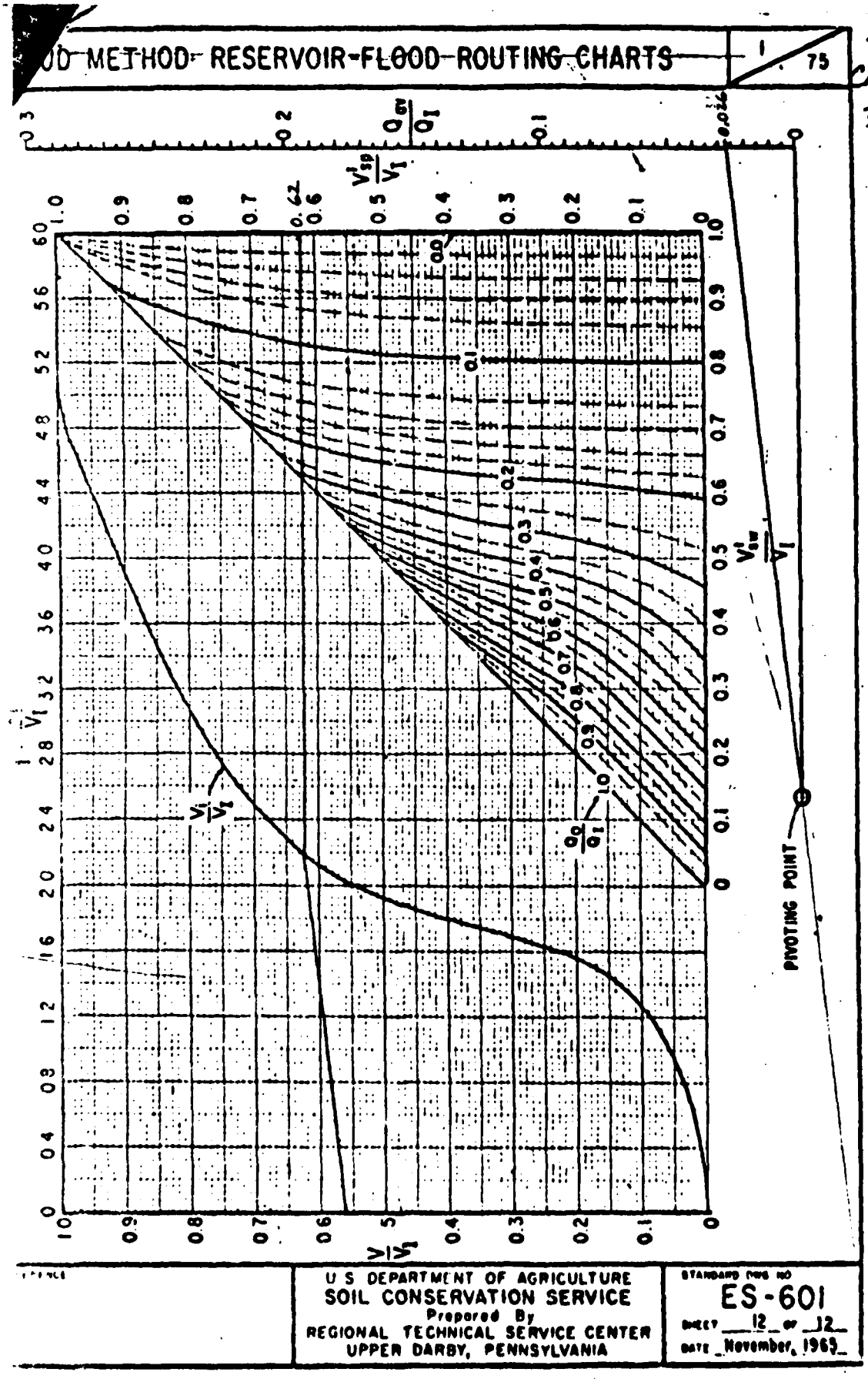
[illegible] [illegible]es, z

5. [illegible]: Q_I = 3982 ft³/sec

1	2	3	4	5	6	7	[illegible]	9	10	11	12
E_w ft	V_{tw} AF	V_{sw} AF	V_{sw}/V_I	V'_{sw}/V_I	Q_o/Q_I	Q_o cfs		H_p ft	Q_e/b	b ft	v fps
525.9	35.2	10.2	0.772	0.832	0.1	398.2	286	0.5	0.58	686	
526.4	36.4	11.4	0.863	0.922	0.05	199	86	1.0	1.94	44	
526.9	37.1	12.1	0.916	0.976	0.01	40	-73	1.5	3.92		
527.4	38	13	0.984	1.044							—

526.2 100

[illegible] 8.1 OK. b = 100 [illegible] Slope [illegible]


OD METHOD- RESERVOIR-FLOOD-ROUTING CHARTS
1 / 75
4/6/76
CANDLEWOOD LAKE
3/22/76
PIVOTING POINT
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Prepared By
REGIONAL TECHNICAL SERVICE CENTER
UPPER DARBY, PENNSYLVANIA
STANDARD FORM NO
ES-601
SHEET 12 OF 12
DATE November, 1965

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